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W. A. Brown



Small Arms Training

Volume I, Pamphlet No. 7.

.303-inch Vickers

Machine Gun

Part III (India)

Fire Control Support Platoon

1940

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INTRODUCTION

This pamphlet deals with the various methods of applying machine gun fire. It is written for officers and N. C. Os. whose duty it will be to direct and control fire, but before studying it they should be thoroughly conversant with:—

The Theory of Small Arms Fire .. (S.A.T., Vol. I, Pamphlet No. 1)

The Application of Fire (S.A.T., Vol. I, Pamphlet No. 2)

An elementary knowledge of mathematics will enable the reader to grasp the various methods of fire control without difficulty.

DEFINITIONS

Line of fire.—The direction of the target from the gun.

Flanking fire.—Fire applied from a position on the flank of the troops whom it is intended to cover or support. (See Plate III, page 34.)

Overhead fire.—Fire passing over the heads of our own troops. (See Figs. 16 and 17, page 36.)

Clearance.—The vertical height of the centre shot of the cone above the ground at any point. (See Lesson 67, 2.)

Minimum clearance.—A term used to denote the minimum height of the centre bullet of the cone above the heads of our own troops for them to be safe. (See Lesson 67, 2.)

Fixed line.—A weapon is said to be laid “on a fixed line” when it is so laid that its fire can be applied to a pre-determined area regardless of darkness or fog, etc. Fire on fixed lines is the best method of defence in darkness or fog. (See Plate III, page 34.)

Angle of sight.—The angle contained between the line of sight and the horizontal plane. The angle is said to be positive (+) when the target is above the horizontal plane through the gun position and negative (—) when the target is below it. (See Lesson 57, pages 4, 5 and 6.)

Tangent angle.—The angle which the axis of the barrel makes with the line of sight. (See Lesson 57, pages 4, 5 and 6.)

Quadrant angle.—The angle which the axis of the barrel makes with the horizontal plane. (See Lesson 57, pages 4, 5 and 6.)

Safety angle for flanking fire.—The minimum lateral angle by which a line of fire must clear our own troops in order to ensure their safety. (See Plate III, page 34.)

Safety angle for overhead fire.—The minimum angle which must be included between the axis of the barrel and the line of sight to our own troops in order to ensure their safety when fire is being directed over their heads. (See Fig. 18, page 37.)

SECTION 19—GENERAL PRINCIPLES

1. Object of fire control.

The object of fire is either to prevent the movement of the enemy or, by neutralising his fire, to assist the movement of our own troops. To attain this object the commander of one or more fire units must be able to apply the fire of his weapons where he wishes. This is fire control.

2. Basic principles.

The basic principles governing the application of fire of sections of the Support Platoon are:—

(i) **Effect.**—The whole target must be engaged as effectively as possible.

(ii) **Safety.**—The safety of our own troops must be ensured.

(iii) **Surprise.**—The target must be hit as soon as possible after fire is opened, or the moral and physical effect of surprise—which cannot be over-estimated—may be lost.

(iv) **Economy.**—Ammunition supply is always a problem. It is wrong to expend more ammunition than is required for the task in hand.

(v) **Margin of error.**—It is often difficult and sometimes impossible to see the strike of the bullets and thereby judge the exact position of the beaten zone. It is not always possible therefore to hit the target by means of observation of fire and correction.

Since there is no quick and reliable way of determining the range exactly, nor of estimating with precise accuracy the effect of climatic conditions, errors of both direction and elevation must be expected.

Rules for fire control must therefore allow for a margin of error. They must be based on the assumption that adequate observation of strike will not be forthcoming, and must aim to apply fire over an area round the target rather than to concentrate on the target itself.

Fire control orders must be framed in accordance with these principles. They should be clear, accurate and as simple as possible.

3. Flexibility.

The system of fire control outlined in the following pages is based on the above principles. It must be regarded as flexible and not rigid. Where the situation does not permit rules to be obeyed to the letter, common sense and a knowledge of the principles will enable effective fire to be applied.

When the extent of the beaten zone can be accurately judged by observation it is clear that procedure may be modified considerably. (See Section 16 and Lessons 50 and 51).

4. Direct and indirect fire.

(i) It is usual to engage a target by direct fire, i.e., by laying on the target over the sights. Its main advantages are:—

Extreme flexibility enabling a succession of targets over a wide arc to be engaged with equal facility.

Simplicity and speed.

Its technical disadvantages are:—

Personal errors of Nos. 1 in laying.

Difficulties of indicating and recognising targets.

Possible obscuration of the field of view.

(ii) Indirect fire is employed—as a general rule—when it is impossible or inadvisable to occupy direct fire positions. Its main technical advantages are:—

The necessity for indicating the target to a number of individuals is eliminated.

The laying of the gun is mechanical and its accuracy is not affected by light or distance.

Its disadvantages are:—

The necessity for additional measurements and calculations.

The problem of crest clearance due to the flat trajectory.

Slightly more complicated drill (as compared with direct fire) and longer time required to come into action.

(iii) In war it is always possible that the field of view may be obscured by natural or artificial means. Consequently, even when direct fire positions are occupied, certain arrangements as for indirect fire should be made as soon as time permits. (See Section 13, Lesson 42.)

(iv) The principles of fire control set forth in this pamphlet apply to both the direct and the indirect methods. But since details of fire discipline are not always the same, direct and indirect fire are treated separately in the remainder of Part III.

LESSON 57—ELEVATION

Instructor's Notes

Stores:—Gun and tripod, range table, blackboard.

First ensure that the class understand the forces which act upon the bullet (S.A.T., Vol. I, Pamphlet No. 1, Sec. 2).

Explain the tangent angle and demonstrate how it is applied to the gun by the sights—show how whenever the gun is laid (direct or indirect) the two components of elevation are the tangent angle and the angle of sight, and explain the quadrant angle.

1. When firing direct up to 2,800 yards, elevation is given to the machine gun by setting the sight at the graduation corresponding to the range to the target and directing the line of sight on to the

point of aim. This process sets the axis of the barrel at an angle above the line of sight (Fig. 1). This is the angle of tangent elevation.

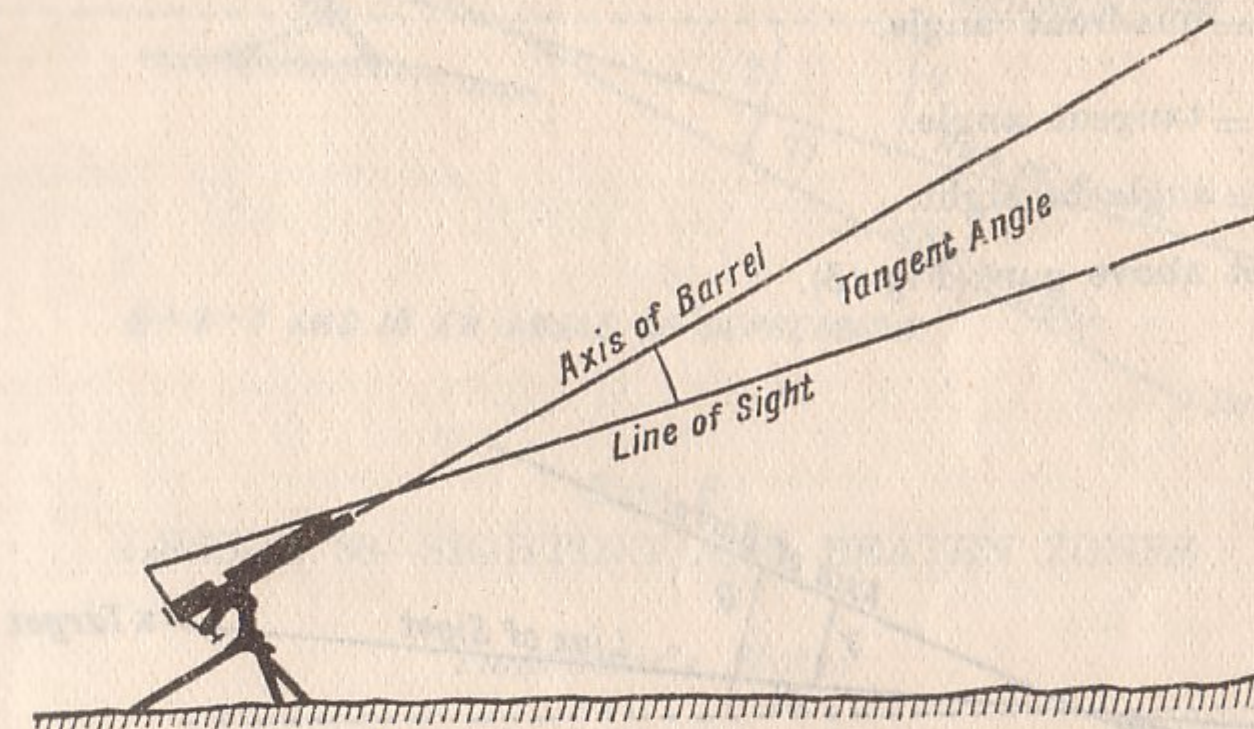


FIG. 1.

(tangent angle) for the range at which the sight is set.* Tangent angles for all ranges have been determined and are laid down in the Range Table.

2. When firing indirect, elevation or depression is placed on the gun by means of the clinometer, an instrument which measures angles with reference to the horizontal. It is necessary, therefore, to be able to express the angle of elevation given to a gun in relation to the horizontal. This angle is known as the quadrant angle, and is angle between the axis of the barrel and the horizontal (Fig. 2).

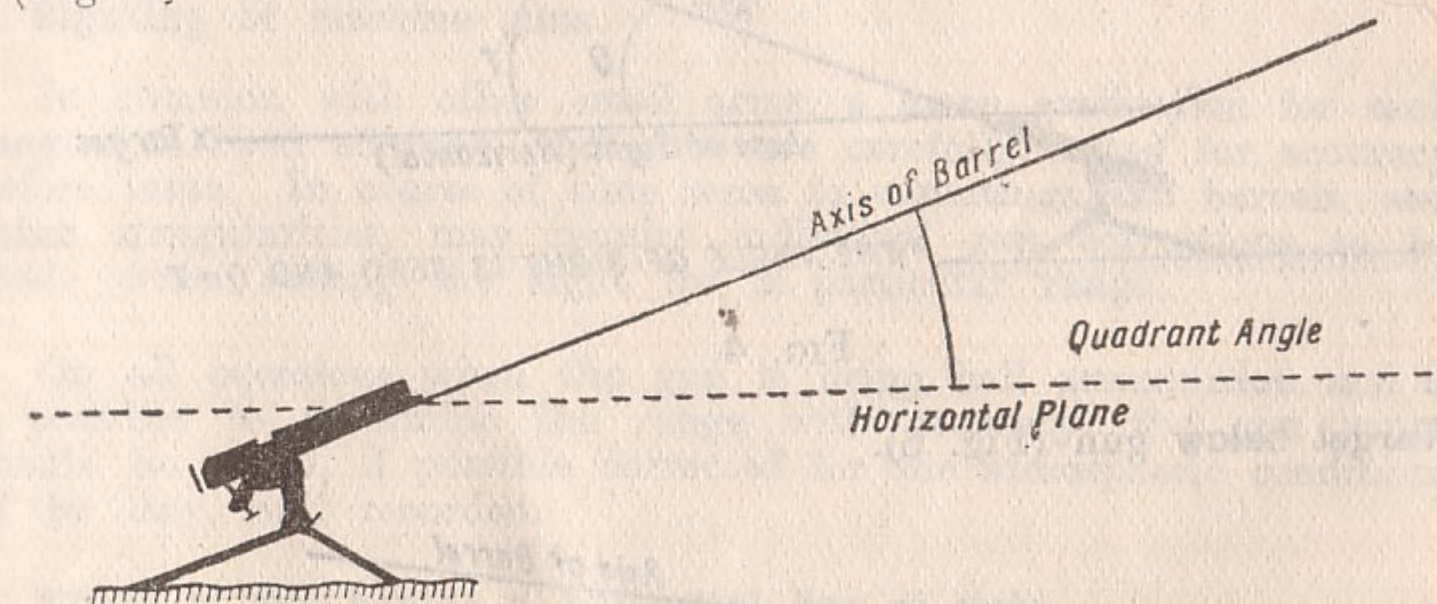


FIG. 2.

The quadrant angle is calculated from the formula:—

Quadrant angle = tangent angle \pm angle of sight. (For angle of sight, see Definition, p. 1.)

* Except where the line of sight is abnormally steep, i.e., in mountainous countries. This is explained in Lesson 59.

The following diagrams, which cover all cases, show how the formula is arrived at:—

Q = quadrant angle.

T = tangent angle.

S = angle of sight.

Target above gun (Fig. 3).

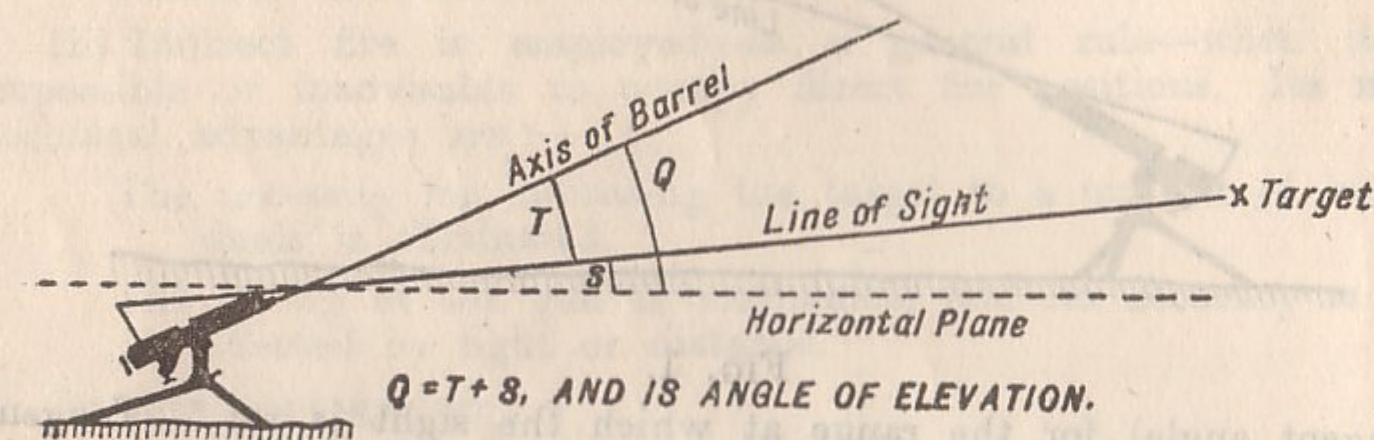


FIG. 3.

Target level with gun (Fig. 4).

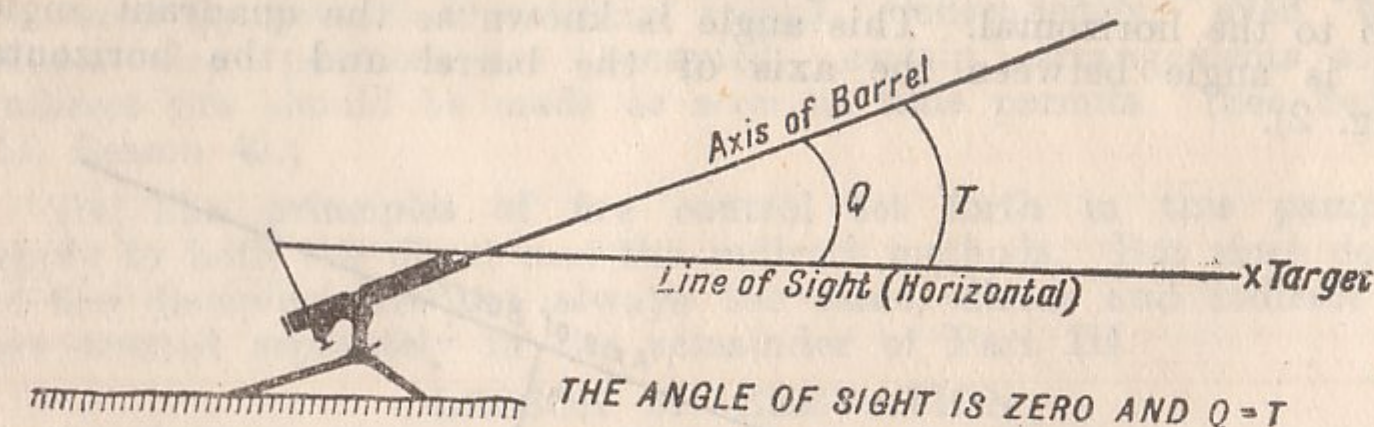


FIG. 4.

Target below gun (Fig. 5).

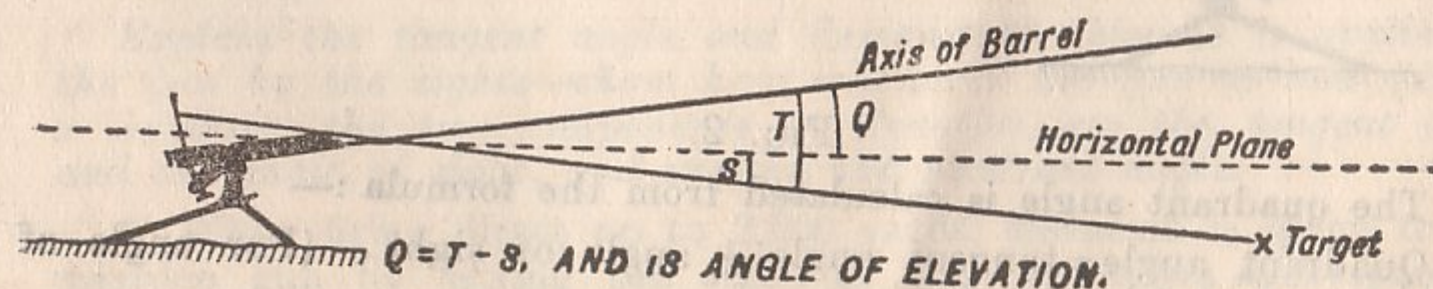


FIG. 5.

Target far below gun (Fig. 6).

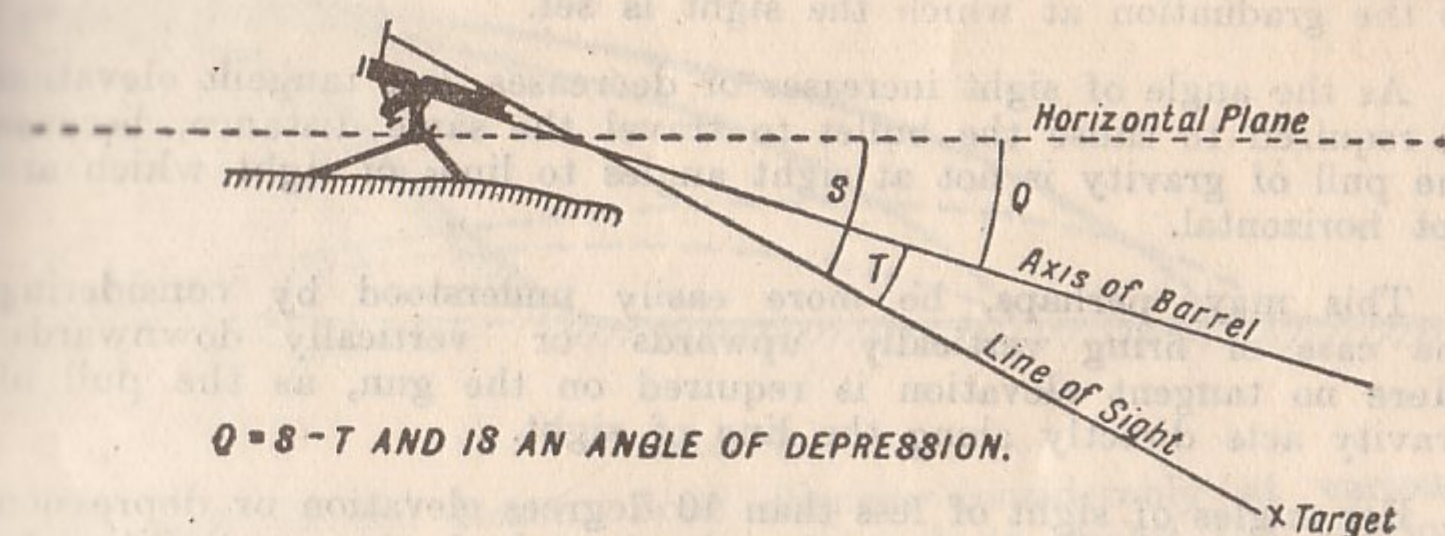


FIG. 6.

LESSON 58—SIGHTING AND BEATEN ZONES

Instructor's Notes

Stores.—Gun and tripod, range table, blackboard.

Method of instruction.—Explain the normal (i.e., approximately horizontal) line of sight, and the abnormal in conjunction with the chart in the range table (p. 16) and para. 2 below.

Explain the beaten zone and how it is affected by ground.

EXPLANATION

1. Sighting of machine guns.

In common with other small arms, a mean graduation for each range has been adopted, and guns are carefully tested for accuracy before issue. In course of time wear to mountings and barrels, and other irregularities, may require individual gun corrections to be made when setting the sight for a particular range.

On all occasions when the gun is firing ball ammunition and it is possible to determine the range with accuracy, the gun range should be noted, if possible corrected for the atmospheric conditions of the day, and recorded.

2. Effect of not having a horizontal line of sight.

The V.M.G. is sighted for a horizontal line of sight. That is to say, if the sight is set at a certain graduation and the gun laid with a horizontal line of sight, a single shot will, in theory, strike the

horizontal plane at a distance away from the gun corresponding to the graduation at which the sight is set.

As the angle of sight increases or decreases, less tangent elevation is required to cause the bullet to travel the same distance, because the pull of gravity is not at right angles to lines of sight which are not horizontal.

This may, perhaps, be more easily understood by considering the case of firing vertically upwards or vertically downwards. Here no tangent elevation is required on the gun, as the pull of gravity acts directly along the line of sight.

For angles of sight of less than 10 degrees elevation or depression the reduction in tangent elevation required is negligible. In mountainous countries, however, it will be necessary to set the sight at a corrected range. A chart from which the corrected range for abnormal angles of sight can be obtained is given in the range table (page 16).

3. Beaten zones.

The beaten zone of the vickers machine gun has similar characteristics to that obtained in concentrated rifle fire. The fixed mounting gives greater accuracy and closer grouping. The dimensions of the beaten zones for various ranges have been obtained by experiment, and are laid down in the range tables. The rules contained in this pamphlet are based on these dimensions, which vary little for different guns and mountings, and hence can be taken as constant for each range.

The length of the beaten zone decreases as the range increases. Beyond 2,000 yards the machine gun beaten zone again begins to increase, this is due to minor differences in the velocity of individual bullets.

Its breadth increases up to extreme range.

The fact that it is very narrow in comparison to its length calls for great accuracy in direction, and renders the gun peculiarly suited to engage targets in enfilade.

The effect of ground on the beaten zone of the light machine gun is in general as shown in Pamphlet No. 1, Sec. 2.

In addition, it should be remembered that plunging fire from a commanding position on to level ground (Fig. 7) will produce a reduced beaten zone.

The table given on page 7 of the Range-Table has been compiled as a guide to the amount the Beaten Zone is reduced or increased according to the slope of the ground on which it falls.

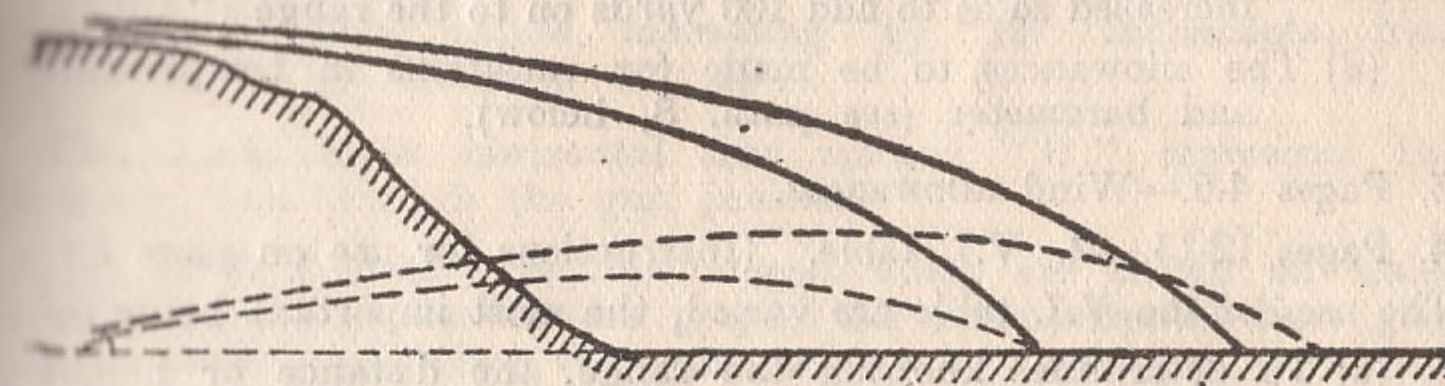


FIG. 7.

The size of the Beaten Zone changes considerably at various ranges. Bursts of fire must be long enough to enable the position of the Beaten Zone to be "found" by observation of strike and to produce the required Fire effect on the target, at all ranges.

The following bursts of fire are laid down as a guide, and should be known to all firers:—

Yards.	Rounds.
Up to 1500	Approx. 20
Over 1500	" 40
Rapid fire at all ranges	" 50

LESSON 59—RANGE TABLE AND CLIMATIC INFLUENCES

Instructor's Notes

Stores.—Range Table, blackboard.

Method of instruction.—Each page of the table should be explained and understood before passing on to the next. The table referred to in para 2, below, should not be explained at this stage.

The class should be given simple exercises in all the other tables and scales until they are thoroughly familiar with their use.

EXPLANATION

1. The range table of the .303-in. Vickers Machine Gun, 1937, consists of:—

- A table giving all the data relative to the shooting of the gun (page 1).
- Tables and graphs of general application to machine-gunnery.

2. Pages 2 and 3.—Lifts, safety angles, minimum clearances, temperature and barometer corrections.

This table contains all information which will normally be required in the preparations or engaging a target, viz.:—

- The tangent angles for all ranges (100's and 50's).
- The safety angles and minimum clearances for all ranges to our own troops.

(To assist in working out overhead problems.)

- (c) The angular amount by which each elevation has to be increased so as to add 100 yards on to the range ("lift").
- (d) The allowances to be made for variations in temperature and barometer (see para. 8, below).

3. Pages 4-6.—Wind allowances.

4. Pages 12-13.—A V.I. table. (Instructions for use on page 8.)

The uses of the V.I. table are varied, the most important being:—

- (a) To determine, knowing the range, the distance or height subtended by a certain angle.
- (b) To determine, knowing the range, the angle subtended by a certain distance or height.

In Fig. 8 if G is the gun and GA the range, then AB is the distance subtended by AGB at the range GA, and CD is the distance subtended by AGB at the range GC.

Similarly, the angle AGB is said to subtend AB and CD at the ranges GA and GC respectively.

5. Page 14.—A formula for determining angle of sight and allowance for moving targets.

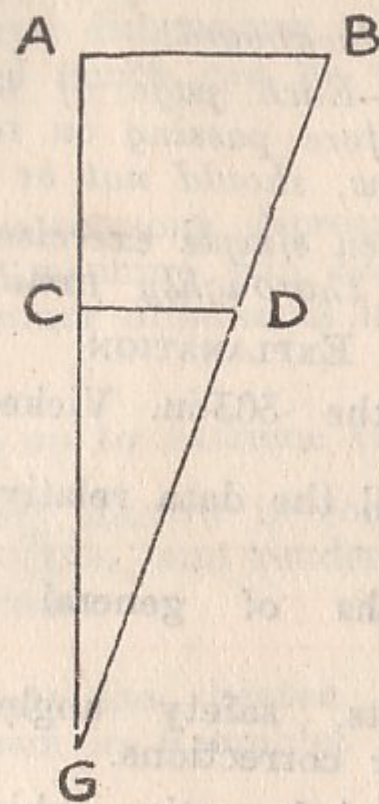


FIG. 8.

6. Page 15.—Graph for calculating quadrant elevation and clearances. (The Q.A. graph.)

This graph is formed by plotting to scale the path of the centre bullet for quadrant angles, increasing by 10' increments, from depression 3° to elevation 10° 10'.

The thick, black horizontal line marked "O" represents the horizontal line through the gun position.

The vertical lines give the ranges, which are shown on scales at the top and bottom of the graph, and the horizontal lines give heights above and below the gun position in metres, as shown on the left-hand side of the graph, and yards on the right-hand side of the graph.

The chief use of the graph is to determine the Q.A. for targets at any height above or below the gun.

For example:—

Range to target 1,600 yards.

Height of target above gun 35 yards.

Plot the target on the graph, i.e., run up the vertical line through 1,600 on the bottom range scale, to a point directly level with 35 yards on the right-hand scale. (Above the thick, black, horizontal line.)

Note the curve which passes nearest to this point, viz.:—El. 3° 50'.

This is the Q.A. required.

The graph is also used in connection with crest clearance and the safety of our own troops, and at the top and bottom gives information relative to the calculations of these. The use of the graph in this connection is dealt with under the various sections concerned.

7. Page 16.—Chart for firing up or down hill.

8. Climatic influences.

The following are the normal conditions for the sighting of small arms:—

Barometric pressure. 30 inches. (Mean sea level.)

Temperature. 60 deg. Fahrenheit.

Still air.

A horizontal line of sight.

(a) Barometer and temperature.

If the barometer falls below 30 inches, less elevation than is normally required for the distance will be necessary, as the atmosphere being less dense offers less resistance to the bullet. It should be noted that the barometer will fall 1 inch for every 1,000 feet above mean sea level. If the barometer rises above 30 inches, more elevation is required, as the air is denser.

The bullet meets with less resistance in hot weather, when the temperature is high and the air less dense; and greater resistance in cold weather, when the temperature is low. In the former case, therefore, less elevation is required and in the latter more.

Allowances for barometer and temperature variations are normally small, and are not usually necessary except at great heights or under conditions of extreme heat or cold.

Allowances for 1 inch rise or fall of barometer and 10° rise or fall in temperature will be found opposite each range in columns 7 and 8 of pages 2 and 3 of the range table. It should be noted that for a *fall* in barometer, and a *rise* in temperature the allowance to be made is subtracted and *vice versa*.

(b) Wind.

Winds blowing directly along the line of fire from front to rear will affect the elevation, but here unless the wind is very strong and the range long, the allowance required is small.

Winds blowing directly at right angles to the line of fire will affect direction, and have considerable effect on the bullet, particularly at long ranges.

Winds blowing from a direction oblique to the line of fire will affect both direction and elevation.

Although where speed is essential it may be necessary to estimate in minutes the lateral allowance to be made for a side wind, recourse should be had to the graph in the range table, when time permits.

On page 4 of the range table is given a table showing the effect of wind of various strengths on flags, which may be of assistance in estimating the speed of the wind.

Having obtained this estimation, the allowances required may be obtained from the table on page 6.

The table is constructed to deal with winds blowing directly along or at right angles to the line of fire, and at angles of 45° , $22\frac{1}{2}^{\circ}$ and $67\frac{1}{2}^{\circ}$ to it. It should be noted that $22\frac{1}{2}^{\circ}$ is $\frac{1}{4}$ of a right angle, and $67\frac{1}{2}^{\circ}$ is $\frac{3}{4}$ of a right angle.

To use the table, determine the approximate direction of the wind with reference to the line of fire, and read off the allowance indicated.

Allowances for side winds will be given out to the nearest 15 min.

(c) With reference to (a) and (b) above, barometer and temperature readings, and the strength and direction of the wind may be obtained from the "Meteor" wire, which in war is issued by the meteorological section at certain periods during the day.

If this is not available, artillery batteries can usually give the information required.

LESSON 60—RANGE OR RANGES

Instructor's Notes

Stores.—As for Lesson 59.

Explain.

1. Errors in elevation may be caused by:—

- (a) Inaccuracies in determining the range.
- (b) Incorrect allowances for climatic variations.

2. In order to form a basis on which to work, it is assumed that personnel can be trained to give the range within a maximum probable error according to the method employed, as follows:—

- (a) By range-finding instrument 5 per cent.
- (b) By estimating from ranges taken with a range-finding instrument 10 per cent.
- (c) From a map of not less scale than 1/25,000 5 per cent.

The error may have been made either way, i.e., the range may have been given too long by the whole amount of the error or too short by the whole amount of the error. Thus, a target cannot be considered as a point but rather as a target which covers in depth a distance equal to twice the probable error in range.

For example.—The range to a point as obtained by range-finding instrument is 1,300 yards.

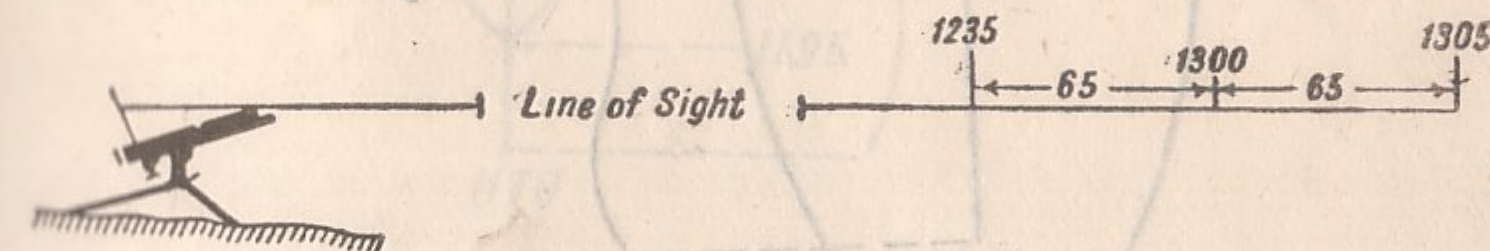


FIG. 9.

In this case (Fig. 9) the target must be considered as extending from 1,235 yards to 1,365 yards. Therefore, the whole of this depth (130 yards) must be engaged when fire is opened.

3. For all practical purposes it may be taken that the centre shot of the beaten zone cuts the line of sight at a range corresponding to the tangent elevation on the gun, and that half the beaten zone falls beyond this point and half short of it.

4. To decide whether or not fire effect will be obtained on a target when fire is opened, it is necessary to compare the length of the beaten zone at that range with twice the probable error in range.

For example :—

"A." (Fig. 10). Range 1,300 yards. (by range-finder).

Error either side 65 yards (5 per cent. of range).

Beaten zone 210 yards (i.e., 105 yards either side).

Thus the length of the beaten zone covers the probable error and fire effect should be obtained at once by giving the same elevation with the same point of aim to both guns of the fire unit.

"B." (Fig. 11). Range 1,300 yards (estimated).

Error either side 130 yards (10 per cent. of range).

Beaten zone 210 yards (i.e., 105 yards either side).

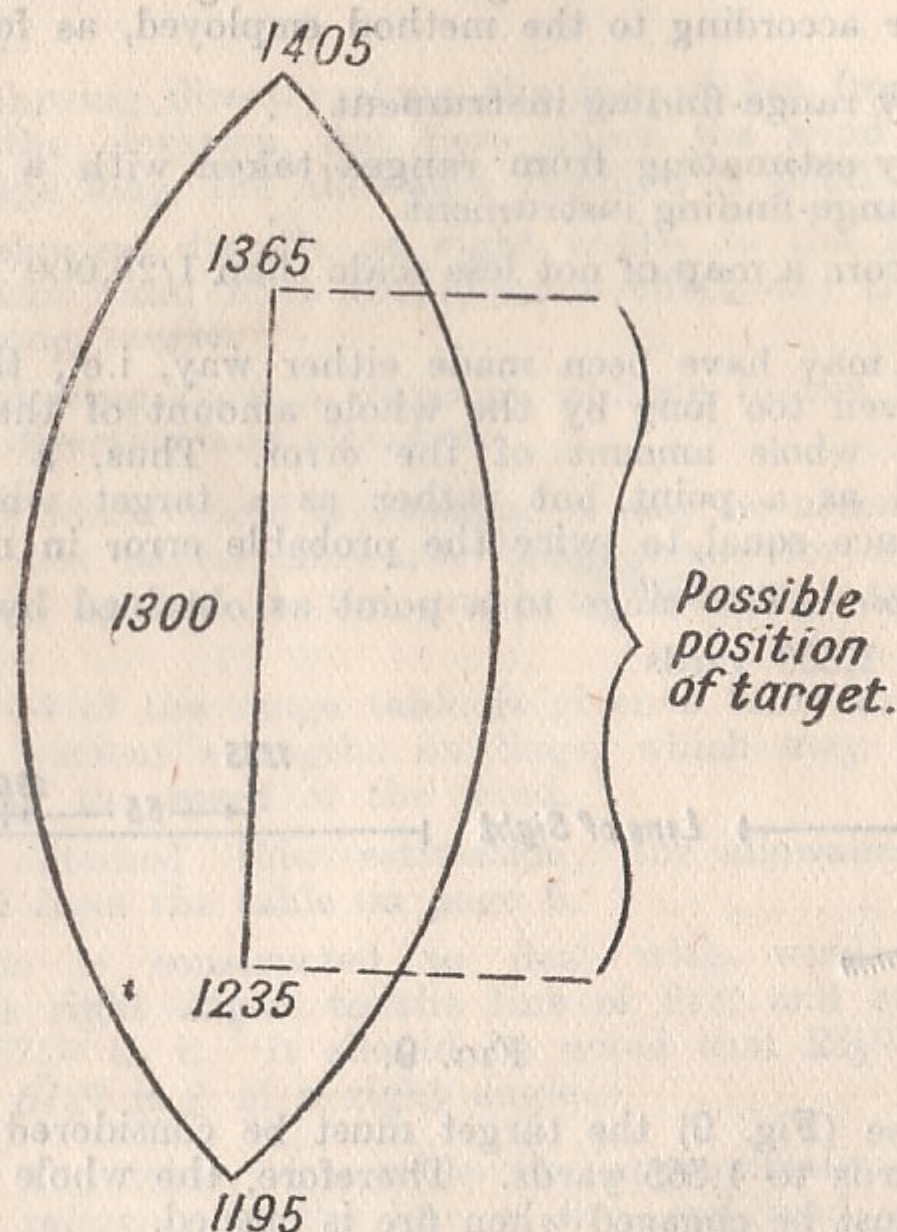


FIG. 10.

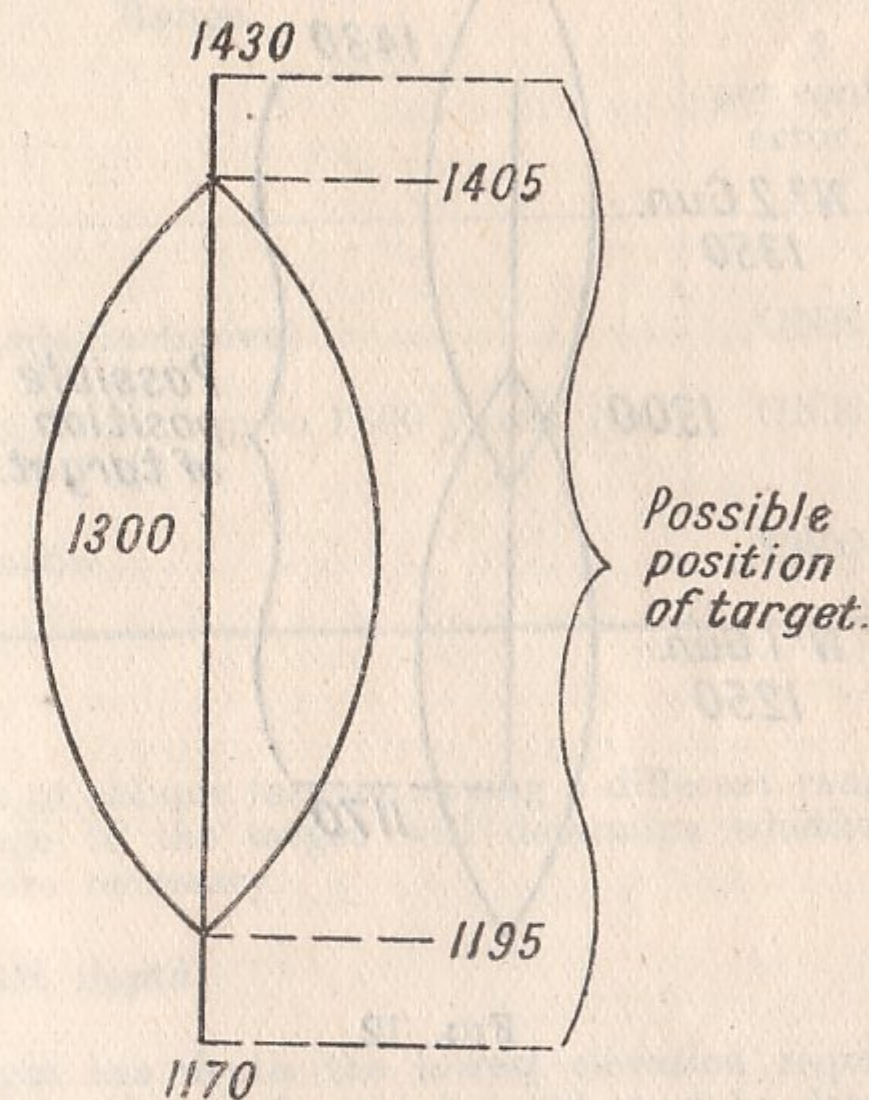


FIG. 11.

Thus the length of the beaten zone must be increased until the necessary depth is engaged. The increase of the beaten zone is effected by giving one gun an elevation of 50 yards under and the other 50 yards over the given range, both guns using the same point of aim. The beaten zone will thereby be increased by approximately 100 yards (Fig. 12). This procedure is termed using "combined sights". When using combined sights the centres of the adjacent beaten zones are always separated by 100 yards. This figure has been chosen as giving a reasonable overlap at all ranges.

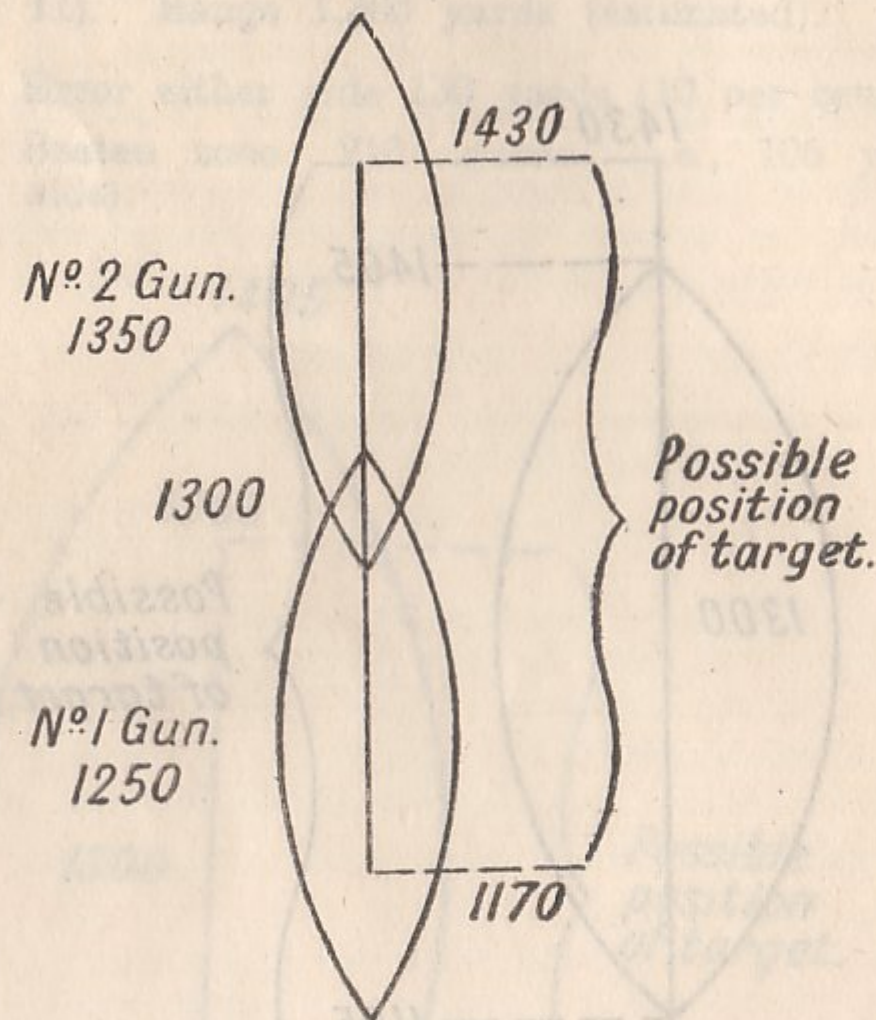


FIG. 12.

At longer ranges when an estimated range is being considered it may be necessary to use more than 2 elevations.

Whenever possible, to prevent unnecessary expenditure of ammunition and loss of time, the rangetaker should obtain the range so that the fire unit commander can engage the target with two elevations only.

5. Rule—

In order that it should not be necessary to compare beaten zones in range tables with twice the probable error in range the table below gives the rules showing the number of elevations to be used at different ranges according to the method of obtaining the range.

Combined Sight Rule.

Range.	No. of elevations required.	
	5 per cent. error.	10 per cent. error.
Up to 1100 yards (inclusive)	ONE	ONE
Above 1100 yards and up to 1500 yards (inclusive).	ONE	TWO
Above 1500 yards	TWO	FOUR

In the case of oblique targets having a different range to each end, the mean range to the target will determine whether or not combined sights are necessary.

6. Targets with depth.

If the target has depth the lowest elevation required to hit the near end and the highest for the far end must be determined according to the above rule. The lowest elevation is given to one gun and 100 yards more to the other. Lifts of 200 yards are then given until the highest elevation is reached.

NOTES.

(i) *One elevation.*—The range given will be the one obtained.

(ii) *Two elevations.*—The ranges given will be 50 yards under and 50 yards over the range obtained.

(iii) *Indirect Fire.*—The combined sight rule is applied by firing first all guns on the lower elevation (50 yards below the range) and then lifts of 100 yards are given until the highest elevation is reached.

SECTION 20—DIRECT FIRE

1. The direct fire unit is the section, because:—
 - (a) Two guns are required to give the necessary volume of fire at Machine gun ranges.
 - (b) At the longer ranges, two guns are required to ensure hitting the target at the first burst or immediately following it.
 - (c) In case of stoppage of one gun, sustained fire can be maintained by the other.
 - (d) It can be easily concealed and is not too vulnerable.
2. The requirements of fire control necessitate the two guns being under the command of a fire controller who is supplied with a rangetaker to enable him to determine the range.
3. In order to avoid casualties the two guns of a section in action should be as far apart as possible, provided that the section commander is able to control both guns by voice.
4. With reference to para. 1, above, at distances beyond 1,500 yards the volume of fire produced by a section cannot always be relied on to give results proportionate to the expenditure of ammunition, and the fire of two or more sections may have to be directed on to the same target from their respective positions.

LESSON 61—FIRE ORDERS—DIRECT

Instructor's Notes

Stores.—Two guns and tripods, two directors, range tables, slide rules, landscape target, blackboard.

This lesson should be carried out indoors with a blackboard and landscape target initially in the form of a lecture.

1. Explain that the following is the procedure for engaging a target by a direct fire unit.
 - (a) The fire controller, by means of a fire order, gives an elevation and indicates a point of aim on the target for each gun.
 - (b) Each firer sets his sight at the elevation ordered, and by traversing the gun, and the use of the elevating gear, directs the line of sight on to the point indicated for the gun. Thus the gun is laid initially for both elevation and direction.
 2. Fire orders are given in a sequence, laid down in para. 3 below, and must not be departed from.
- Rigid adherence to the sequence will ensure that errors and omissions are detected immediately, and, further, that the personnel, knowing what to expect, will act more quickly.

The orders must be given clearly, the fire controller facing towards the guns, and loud enough for both guns to hear.

He must make up his mind what is the correct order to give before embarking on it. Long and unnecessary pauses during which he is coming to a decision as to the next part of the order, can only result in inaccuracies and slovenly drill.

The recipients must have time to act on one portion of the order before another is given.

3. The sequence of a direct fire order is:—

- (a) Range or ranges.
- (b) Indication of the target.
- (c) Method of fire.
- (d) Side wind allowance (if required).
- (e) Rate of fire (if required).
- (f) Order to fire.

When giving out the order, pauses should be made as under, until it is seen that the gun numbers are ready for the next part of the order.

After the range . . . To allow time to set the sights.

At various stages during the indication. . . Time must be given for points to be recognized. When degree methods of indication are used, a pause must be made to enable the angles to be measured.

After method of fire . . . To enable the guns to be laid.

After wind, if any . . . To allow for the picking up of a new point of aim.

4. Range or ranges

(a) Ranges, when ordered to the guns, will be given to the nearest fifty yards, and according to the following examples:—

- 700—Seven hundred.
- 1,000—Ten hundred.
- 1,400—Fourteen hundred.
- 1,450—Fourteen fifty.
- 2,000—Twenty hundred.
- 2,300—Twenty-three hundred.
- 2,350—Twenty-three fifty.

(b) For the first target the section commander will usually obtain the range from the range-taker, but where the situation demands it, he should not hesitate to estimate the range. For subsequent targets, to save time, ranges are taken, or estimated, from the range card.

(c) One range is given to both guns, or a different range to each gun, in accordance with the combined sight rule. (Lesson 60.)

If one range is ordered to the two guns the range will be preceded by the word "all," e.g., "all—ten hundred."

If two elevations are necessary, they will be given in the form:—
"No. 1—Sixteen fifty."

"No. 2—Seventeen fifty."

(d) Except in the engagement of targets where the right end has a greater range than the left end, No. 1 gun is always given the lower elevation.

(e) If the wind is sufficiently high to warrant a correction for elevation, the allowance required will be calculated (Lesson 59) and converted into yards. The range will be corrected before being given out.

5. Indication

The section commander will indicate the target as laid down in Lessons 34 and 35. It should be noted that when switching from one target to another the last target is often the best aid in indication.

6. Method of fire

(a) Order "right and left 2 taps."

Guns are laid on the centre of the target.

No. 1 gun traverses to the left first and No. 2 to the right.

(b) Order "traversing."

No. 1 gun is laid on the right end and No. 2 on the left end of the target.

Both guns traverse across the target.

On completion of the "method of fire" order, the section commander will order "Lay."

7. Side wind

The section commander will either estimate the side wind required or calculate it to the nearest 15 minutes (Lesson 59). It will be ordered to the guns in the following form:—

"Wind—right (or left).....taps."

Nos. 1 traverse their guns across by the amount ordered, note the new point of aim, and inform Nos. 2 when ready.

If the allowance required is more than 3 taps it should be ordered in degrees. Nos. 1 by means of a hand angle find their new point of aim.

If no correction is necessary, this heading is omitted from the order.

8. Rates of fire

(a) (i) When "Normal" rate of fire is required, the executive order for fire to be opened will be "Fire," omitting the word "normal."

(ii) When "Rapid" rate of fire is required, the word "rapid" will immediately precede the order "fire."

(iii) "Harassing fire": this will be delivered at irregular intervals and for uncertain periods, at "normal" and "rapid" rates. The commander ordering this type of fire, will specify the rates and duration required.

(b) Normal	1 Belt in 2 minutes.
Rapid	1 Belt in 1 minute.

9. The order to fire

This will normally be given by the fire controller ordering "fire."

If more convenient he may signal "fire." (See Sec. 9, Signals.)

Attention is called to Lesson 58—Length of bursts.

10. The following orders may be given during a shoot:—

(a) "Stop"

This order is normally given by signal, the arm being waved horizontally to and fro.

(b) Ranging corrections

(i) Direction.

The section commander orders the necessary deflection to one or both guns as required.

Nos. 1 pick up the new point of aim in the new line.

Examples:—

All—Right 2 taps.

No. 1—Left 1 tap.

(ii) Elevation.

The section commander decides on the correction, and either gives out a new range or orders "up" or "down" by the amount required.

Examples:—

All—Fourteen hundred.

No. 2—Up fifty.

All—Down one hundred.

All—Up to two minutes.

(Corrections must be in minutes after the Dial or Handwheel method of indication, where a gun aiming mark has been picked up.)

(c) "Go on"

This order may be given verbally or by making the signal to fire.

11. Practise squad in open country.

LESSON 62—APPLICATION OF FIRE—DIRECT

Instructor's Notes

Stores.—Blackboard. Landscape target.

The subject-matter will be given in the form of a lecture.

1. Basis of fire control rules. (See also Sec. 19, 2)
 - (a) Surprise factor. The target must be hit as soon as possible.
 - (b) Limitations of observation. It cannot always be assumed that strike will be seen.
 - (c) Errors in direction and elevation cannot be avoided.

Hence the principle of engaging an area.

2. The principles on which the rules are framed

- (a) The whole area in which the target may lie must be covered by fire.
- (b) The maximum traverse for a fire unit of two guns is 50 yards. (See also Lesson 64, 3.)

Lifts must overlap.

3. Considerations affecting the area to be engaged

- (a) Width.
 - (i) Inaccuracies in wind estimation.
 - (ii) Slight inaccuracies in laying, wear, etc.
- (b) Depth.
 - (i) Inaccuracies in obtaining the range. (Lesson 60).
 - (ii) Incorrect climatic allowances.
 - (iii) Wear in the gun.

4. Classification of targets

Targets are classified as falling in one of three groups:—

Group A—Targets up to 30 minutes wide at all ranges, without depth or with depth up to approximately 200 yards. (Lesson 63.)

Group B—Targets with width between 30 minutes and approximately 50 yards, without depth or with depth up to approximately 200 yards. (Lesson 64.)

Group C—Moving targets. (Lesson 65.)

NOTE.—When the depth of the target exceeds 50 yards, in view of the number of lifts required to cover the target, the fire of more than one section will be required. Each section being given a different point of aim.

5. Methods of fire applicable to direction

- (a) "Right and Left 2 taps."
 - (i) Both guns have the same point of aim.
 - (ii) To overcome errors in direction, Right and Left 2 taps is ordered, at all ranges. This also allows for the width of the target up to 30 minutes.
 - (iii) The guns traverse inwards and then outwards.
 - (iv) In certain overhead fire cases, the traverse right and left may be increased.
- (b) "Traversing."
 - (i) No. 1 is laid on the right and No. 2 on the left of the target.
 - (ii) Both guns traverse across the whole of the target (lateral or oblique).
 - (iii) To overcome errors in direction, in all cases each gun overlaps the flanks of the target by 2 taps.

LESSON 63—GROUP A TARGETS

Instructor's Notes

Stores.—Blackboard, landscape target, field glasses.

1. Explain

Group A targets without depth or with depth up to approximately 200 yards will be engaged by traversing right and left 2 taps.

The guns are laid on the centre of the target, and the firer will traverse right and left 2 taps at all ranges.

As both guns have the same point of aim, two elevations can be fired simultaneously if required. When this is done, the lower elevation will be given to the gun opposite the near end of the target. [See Lesson 61, 4 (d)].

The depth of a target will be taken up by lifts of 200 yards until the far end is engaged.

If the difference in angle of sight between the two ends is great extra lifts will be given.

2. Illustrate a section engaging a Group A target, at a range of 1,000 yards. (Fig. 13.)

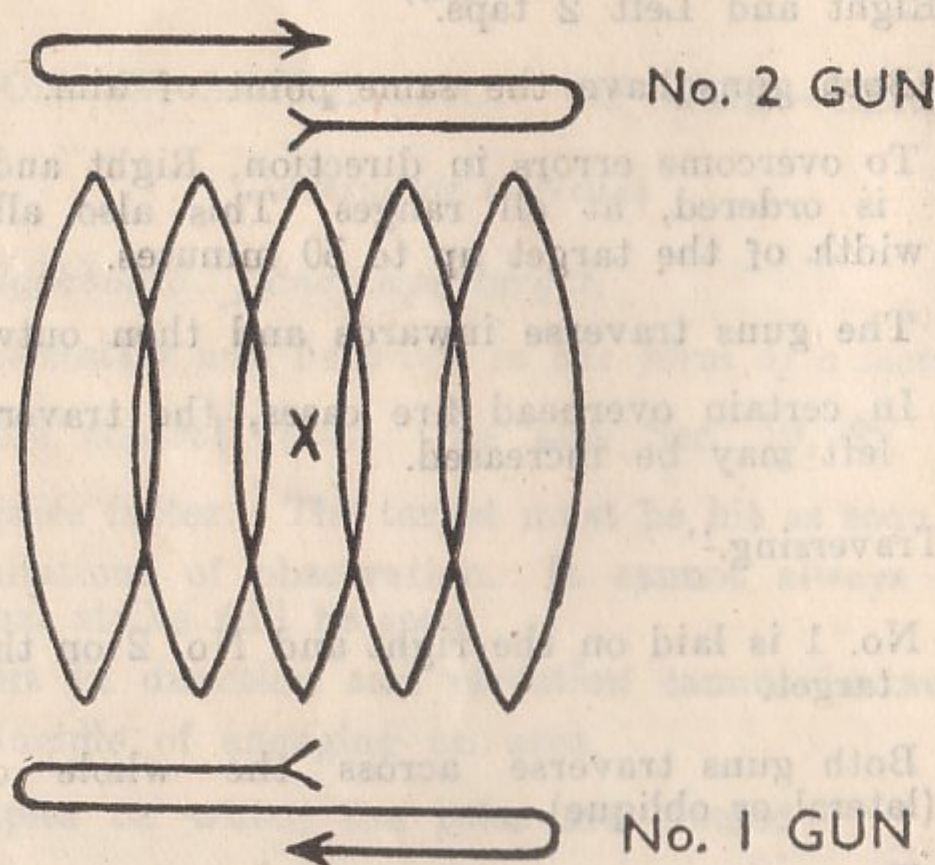


FIG. 13. RIGHT AND LEFT 2 TAPS.

3. Examples of fire orders to engage Group A targets.

The following reference points have been selected on the landscape as shown in Plate I.

(a) Haystacks (R. P. 1) left bottom corner known as **Stack**.

(b) Two poplars (R. P. 2)—left poplar known as **Poplar**.

Target "A." Range 850 yards (by range-finder).

All—850.

Right of arc—pond—near side—large tree.

Right and left 2 taps.

Lay.

Fire.

Target "B." Range 1,600 yards (by range-finder).

No. 1—1,550.

No. 2—1,650.

Poplar—right 3 o'clock 3 degrees—bush.

Right and left 2 taps.

Lay.

Wind—right 1 tap.

Fire.

Target "C." Range 1,150 yards (20' wide) (estimated range).

No. 1—1,100.

No. 2—1,200.

Right of arc—4 large trees.

Right and left 2 taps.

Lay.

Wind—left 1 tap.

Fire.

Target "D." Range 1,000 yards (30' wide) (estimated range).

All—1,000.

Poplar—slightly left and below—House.

Right and left 2 taps.

Lay.

Fire.

Target "E."

950 yards near end (range-finder).

1,000 yards far end (range-finder).

No. 1—950.

No. 2—1,050.

Stack—left 7 o'clock—left edge of ploughed field.

Right and left 2 taps.

Lay.

Wind—right 3 taps.

Fire.

Target "F."

1,500 yards near end (range-finder).

1,700 yards far end (range-finder).

Difference in line of sight between ends 20 minutes.

No. 1—1,500.

No. 2—1,600.

Poplar—right 4 o'clock 2 degrees—hedgerow in enfilade.

Right and left 2 taps.

Lay.

Fire.

Stop.

All—up 200.

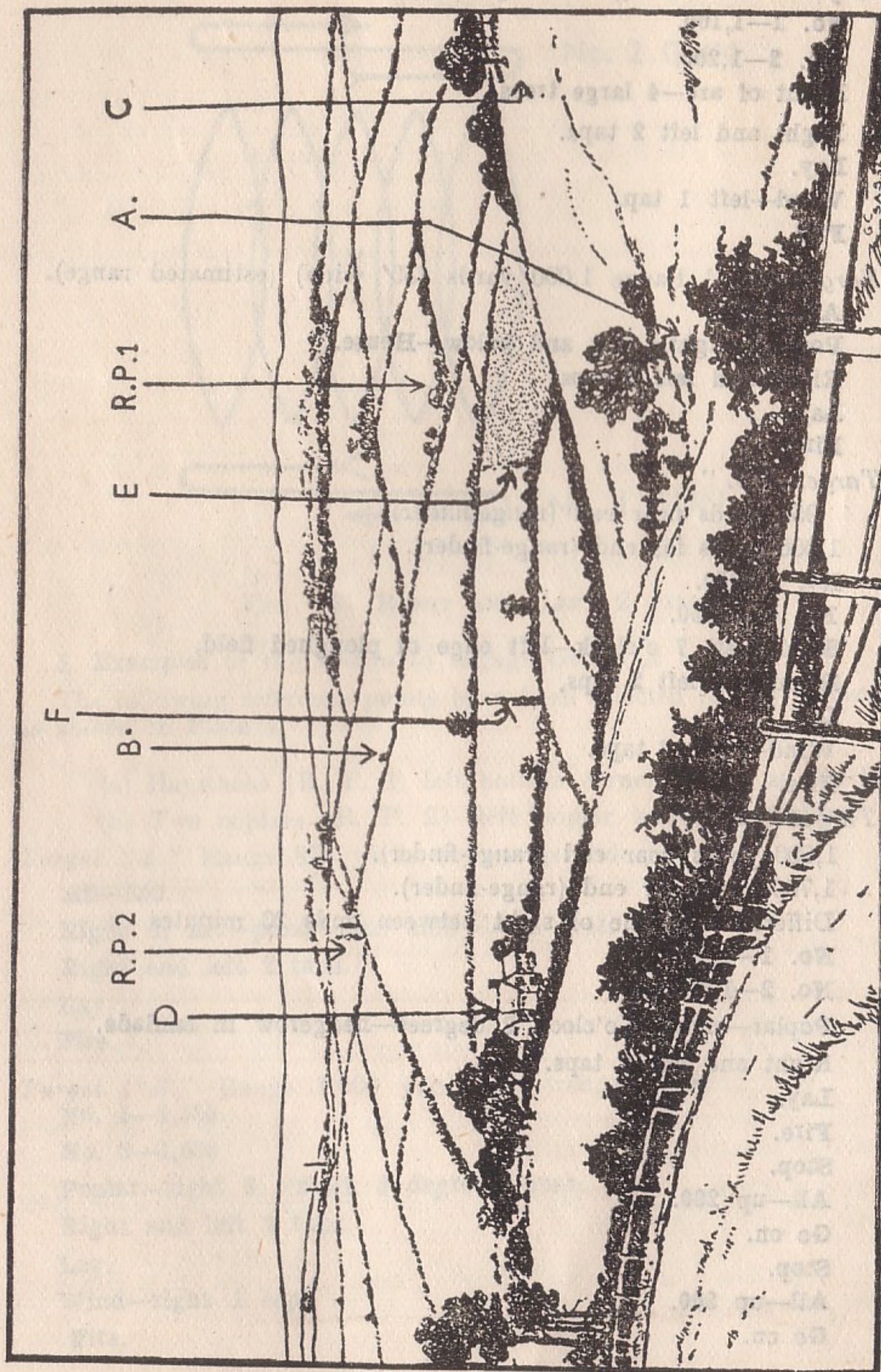
Go on.

Stop.

All—up 200.

Go on.

PLATE I.



LESSON 64—GROUP B TARGETS

Instructor's Note

Stores.—As for Lesson 63.

1. Explain

Group B targets without depth or with depth up to approximately 200 yards will be engaged by traversing fire.

Errors in direction will be overcome by each gun traversing outside the ends of the target by 2 taps.

As both guns will traverse the whole of the target, where combined sights are necessary, two elevations can be fired simultaneously. When this is done, the lower elevation is given to the gun opposite the nearer end of the target.

If the ends of the target as indicated are oblique, e.g., "from tree to left 11 o'clock, bush," then, by carrying out an oblique traverse, the difference in angle of sight will automatically be taken up. If, however, a horizontal axis is indicated, e.g., "near edge of the field," then extra lifts must be given as for targets of Group A, if required by the difference in the angle of sight.

As with Group A targets, the depth of a target will be taken up by lifts of 200 yards.

2. Illustrate

A fire unit engaging a target about 50 yards wide, at a range of 1,000 yards (Fig. 14).

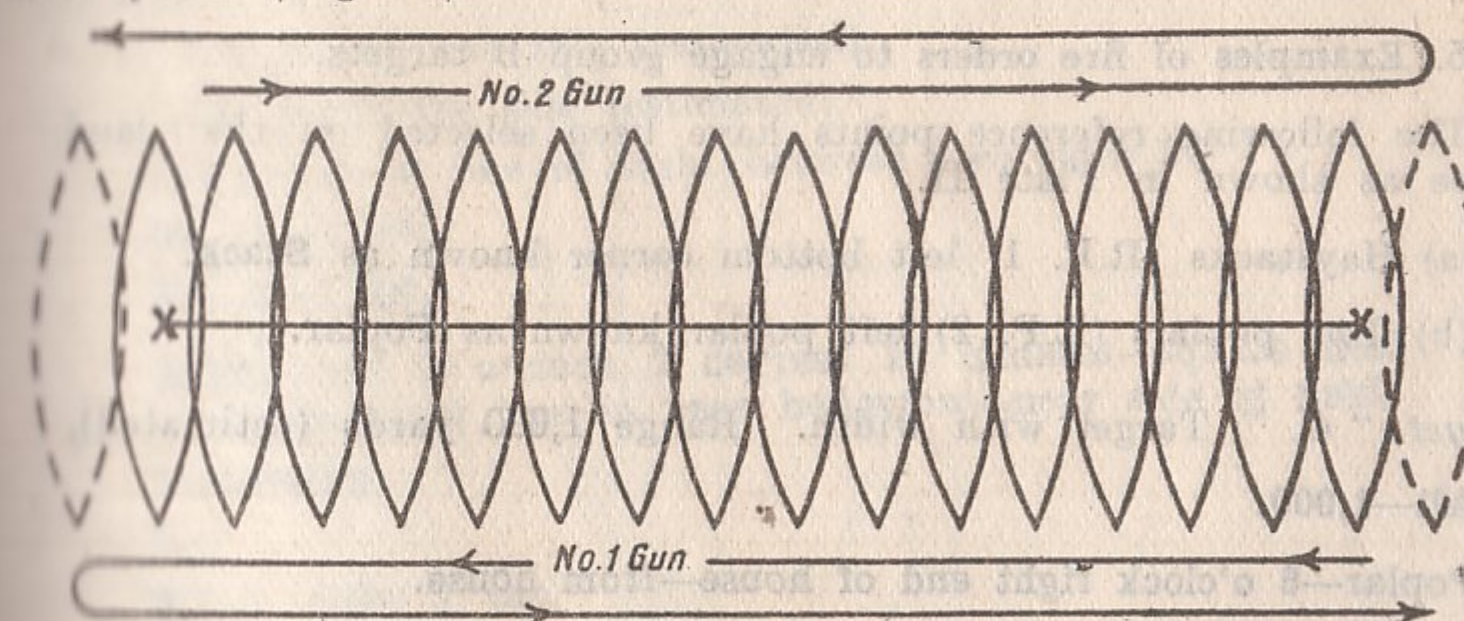


FIG. 14—TRAVERSING.

- (a) x . . . x are the original points of aim.
 (b) The dotted beaten zones on the flanks of the target represent 2 taps outside. (See para. 1, above.)

3. Explain

It has been found that the greatest target frontage which can be engaged effectively by a fire unit of two guns, without undue delay and excessive expenditure of ammunition, is about 50 yards.

4. Explain and illustrate

The target frontage is considered as the angular width subtended at the guns, and not the actual length of the target, e.g., in Fig. 15 the distance to be taken into account is AC and not AB.

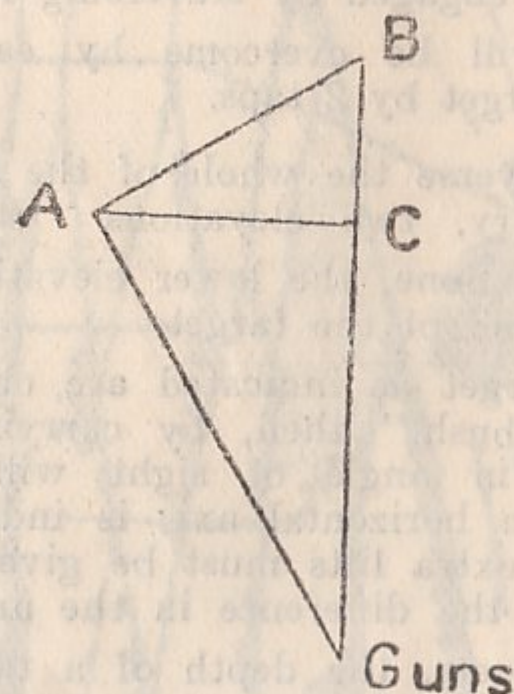


FIG. 15.

5. Examples of fire orders to engage group B targets.

The following reference points have been selected on the landscape as shown in Plate II.

- (a) Haystacks (R.P. 1) left bottom corner known as **Stack**.
- (b) Two poplars (R.P. 2) left poplar known as **Poplar**.

Target "G." Target with width. Range 1,000 yards (estimated).

All—1,000.

Poplar—6 o'clock right end of house—from house.

To—Right 3 o'clock 2 degrees—bush.

Traversing—Lay.

Fire.

Target "H." Target with width. Range 1,500 yards (range finder)

All—1,500.

Poplar—right 4 o'clock 4 degrees—bush—from bush—to left
9 o'clock—where hedgerow disappears behind large tree.

Traversing.

Lay.

Wind—right 2 taps.

Fire.

Target "I."

1,670 yards right end (range-finder).

1,470 yards left end (range-finder).

No. 1—1,550.

No. 2—1,450.

Poplar—from poplar—to—right 2 o'clock—trees at right end
of Church—right tree.

Traversing.

Lay.

Fire.

Stop.

All—up 200.

Go on.

Target "J."

1,170 yards near side (estimated).

1,345 yards far side (estimated).

Difference in line of sight between two sides 20'.

No. 1—1,100.

No. 2—1,200.

Stack—left 8 o'clock 2 degrees 20 minutes—square field with
prominent tree in near hedgerow—near side of field.

Traversing.

Lay.

Wind—right 1 tap.

Fire.

Stop.

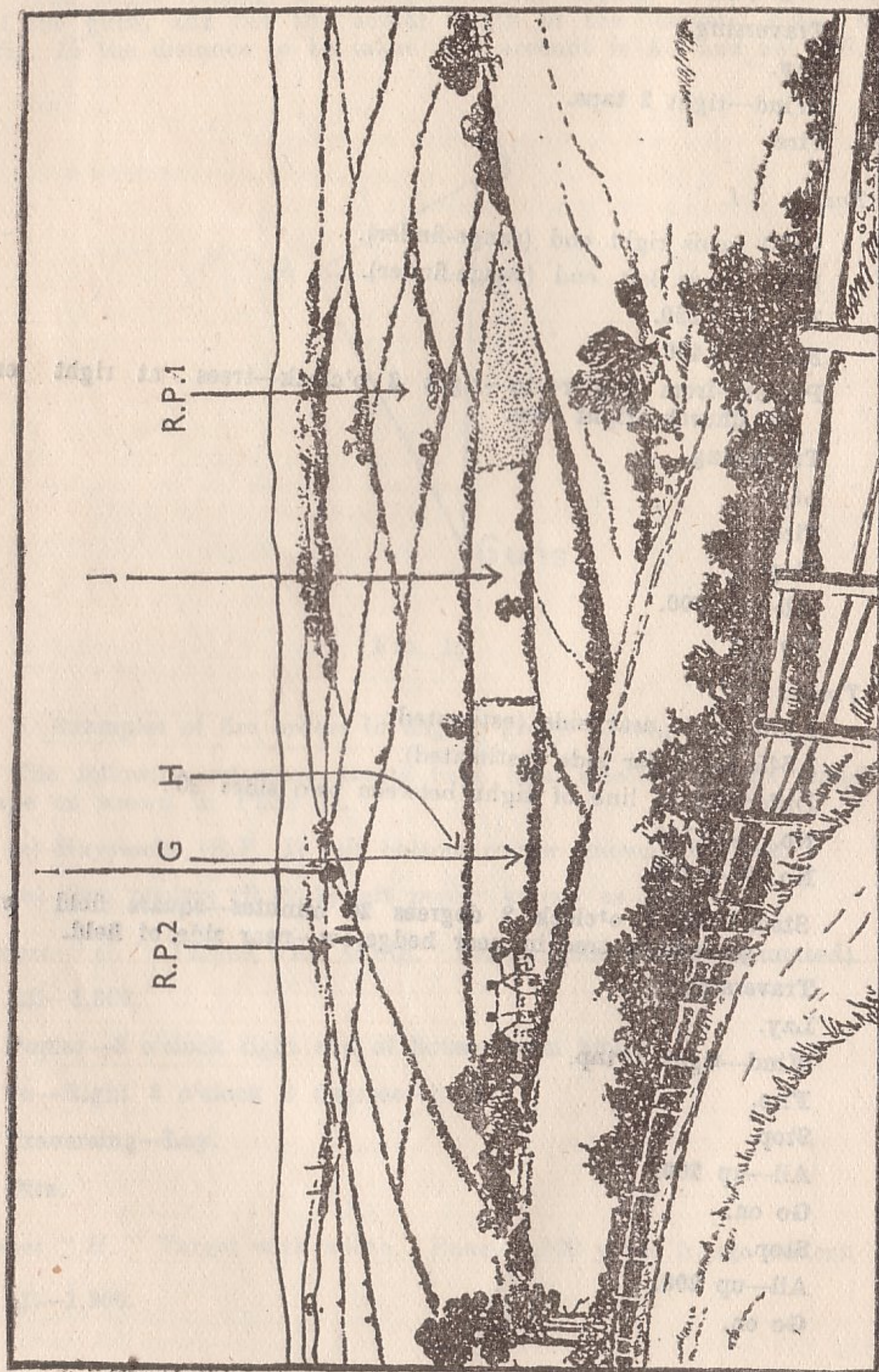
All—up 200.

Go on.

Stop.

All—up 200.

Go on.



LESSON 65—GROUP C TARGETS

Instructor's Notes

Stores.—Blackboard, range tables, vehicles and fatigue men to act as targets.

Explain

1. (a) Fire orders must be simple and as short as possible, otherwise the opportunity of engaging the target may be lost.
- (b) The fire unit commander will maintain control until, owing to the closeness of the range or other factors, greater fire effect may be expected from gun control. He must change to gun control before unit fire control breaks down.

- (c) When engaging a moving target, whether by section or gun control, attention must be continually directed to :—

The changing line of sight, horizontally and vertically.

The alterations in range.

The maximum effect will only be obtained by quick judgment and a thorough knowledge of the light machine-gun beaten zones.

Fire should be directed in front of the target rather than on to it.

Because of the limited time that an armoured fighting vehicle will take to pass through the beaten zones, a burst of fire should be not less than 50 rounds, in order to ensure the maximum weight of fire during this period.

2. Refer to Range Table, 1937, page 14—Allowance for moving targets.

3. There are three methods of engaging moving targets :—

- (i) Traversing in front; suitable at ranges over 800 yards for engaging slow moving targets.

- (ii) Engaging an area through which the target is likely to pass. This is suitable for fleeting targets, such as infantry making use of ground, cavalry and armoured fighting vehicles.

- (iii) The swinging traverse, suitable against moving targets at close range, when other methods would be too slow.

4. (a) A slow moving target at a range of over 800 yards.

Method of engaging—Traversing in front.

- (i) Estimate the speed at which the target is moving, and work out the deflections required from the instructions on page 14 of the range table.

- (ii) Give out a rapid fire order to the guns, remembering that the range will, normally, be estimated.

(iii) Remember that Section Control will be maintained for as long as possible; the chances are that the target will disperse after the first burst, but continue to fire at the area in which the dispersed troops are; gun control will seldom be advisable at this range.

(iv) The gun numbers will lay on the head of the target unless otherwise ordered, and will fire a long burst as soon as the gun is laid and the necessary deflection put on; they will then quickly relay as before on the head of the target.

(v) Example of a Fire Order—"No. 1, 1,550. No. 2, 1,650. Centre of Arc, Troops moving obliquely from left to right. Traversing in front 1 tap. Rapid fire."

(vi) Remember that the Fire Controller is responsible for giving new ranges to the guns as he considers advisable; the range will usually be altering all the time.

(b) A fleeting target, when Section Control is maintained.

Method of engaging.—Engage an area through which the target will pass.

It is carried out by :—

(i) Including such areas within the arcs allotted during the preliminary arrangements of the fire plan.

(ii) Choose a convenient point which you consider is in the path of the target. It is considered that it will take one minute to lay the guns on this point, therefore, the point chosen should be some distance ahead of the target. If at all possible obtain a 5 per cent. range to the point, if not, estimate it.

(iii) Give a normal quick fire order on to the point, except "fire."

(iv) From the instructions on page 14 of the range tables estimate the deflection, and when the head of the target is this angle short of the target give the order "**Rapid fire.**" A long burst should be fired by the guns.

(v) If the target disperses engage the area into which it has dispersed, if not pick up another point on the line of its movement and engage it in the same manner.

5. Practise in the open on targets at varying speeds and distances.

SECTION 21—FLANKING AND OVERHEAD FIRE.

1. The provision of supporting fire to our own troops is the main tactical role of the support platoon. The safety of the troops to whom such support is being given must be the first consideration of the commander.

2. Supporting fire can be provided either from a flank or overhead. Where possible, flanking fire positions should be sought, not only because of the greater fire effect generally obtained from the beaten zone in enfilade, but also because fire from a flank can be put down with safety considerably closer to the troops being supported than can overhead fire. Before the occupation of a position for the purpose of overhead fire it is necessary to determine that such fire will be safe to our own troops. This increases the time required for the guns to be brought into action.

3. In order that the safety of the troops may be ensured, it is essential that their position or movements should be observed by or known to the fire controller.

In defence, this should not present any serious difficulty. In attack, the possibility of observing the movements of our own troops will depend on various factors, e.g., the nature of the ground (whether open, close, flat or hilly), obstructions to the field of view, bad visibility, smoke screens, etc. Since such observation can hardly be assured, it is evident that considerable caution will have to be exercised.

4. Apart from the above considerations, the machine gun, by reason of its stable mounting and the close grouping of its fire, is well suited to carry out flanking and overhead fire with safety to our own troops.

5. Flanking and overhead fire are governed by definite rules which are contained in the following sections.

In solving any problem in connection with the safety of our own troops, the worst possible case must be taken as a basis for applying the rule.

LESSON 66—FLANKING FIRE x See note-book

Instructor's Notes

Stores.—Sand model, slide rule.

Method of instruction.—The application of the rules will be explained on the model and the class will then practise on the ground.

1. **Explain** the following are the rules for flanking fire :—

The diagrams in Plate III illustrate examples of Defence and Attack.

(a) The line of fire must not be closer than 5° to the line joining the gun and the flank of our own troops.

Defence.—The Fixed Line must not be laid closer than 5° from the forward edge of the F.D.L.

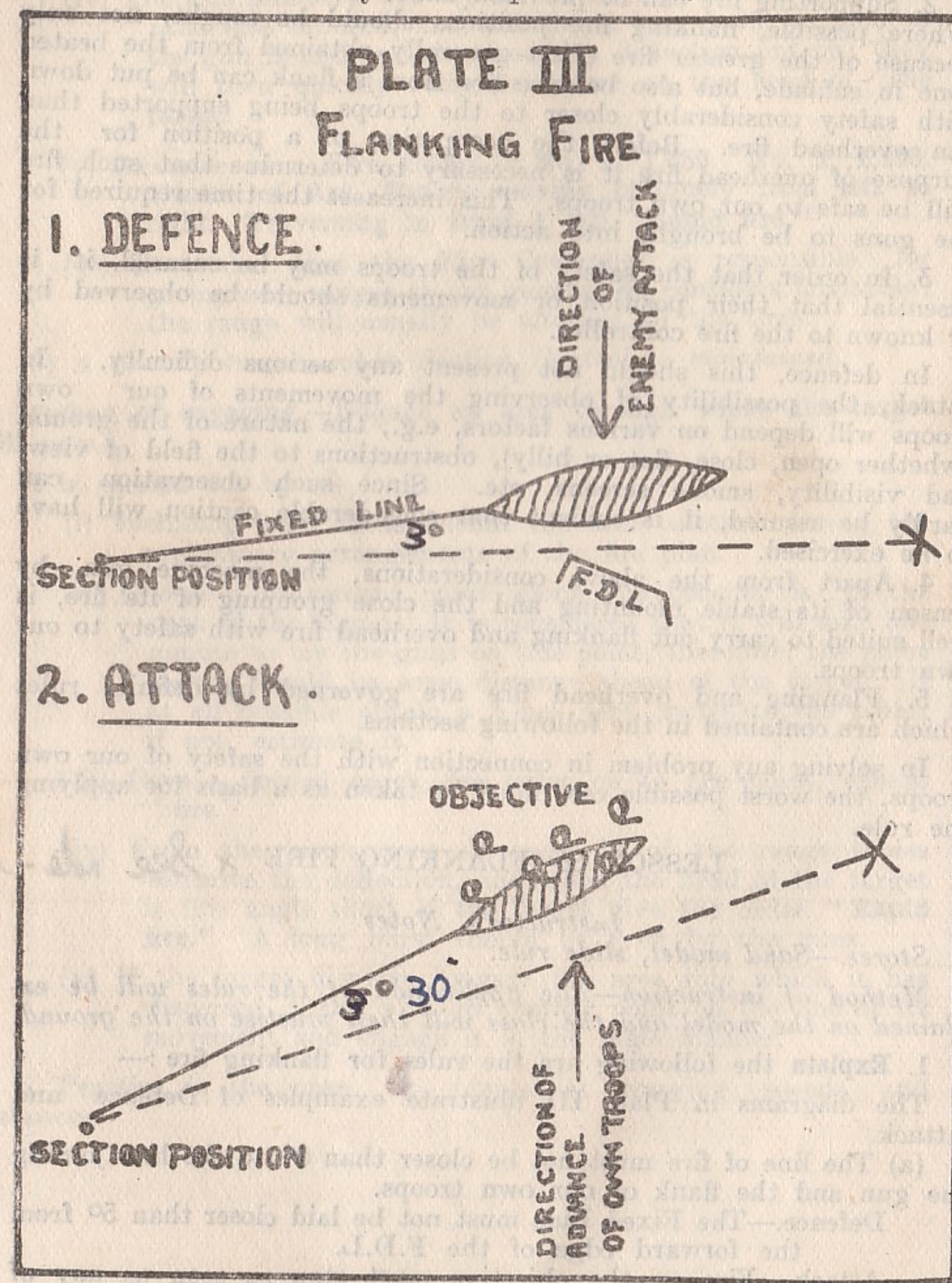
Attack.—Fire on the objective must stop as soon as any of our own troops reach a line 5° from the objective.

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(b) The 5° limit extends to a point (X) the range to which must not be less than 500 yards beyond the highest elevation used.

(c) This type of fire must not be attempted if the position of our own troops in the vicinity of the danger area is unknown.

As already pointed out, this entails either observation of our own troops, or a timed programme, based on a rate of advance, which must not be exceeded by the troops concerned.



2. The lateral allowance of 5° is made up as follows:—

(a) 3° which covers:—

i. Minor inaccuracies in aiming and traversing.

ii. Movement of the tripod settling in during the first burst of fire, etc.

iii. Half the width of the beaten zone.

iv. Allowance to ensure the safety of our own troops.

(b) 2° which allows for:—

i. The Right and Left 2 taps for group "A" or the 2 taps outside the limits of a group "B" target.

ii. The amount any normal wind might blow the bullets in towards our own troops.

LESSON 67—OVERHEAD FIRE (THEORY)

Instructor's Notes

Stores.—Blackboard, slide rule, range table.

Method of instruction.—The theory contained in this lesson will be explained and the class will work out simple problems on the safety angle. It will be made clear that these problems are in practice solved on the slide rule (Lesson 68).

1. Explain

Rules for overhead fire.

(a) Ranges to our own troops must be known to within 5 per cent., i.e., taken by range-finder, or from a map of not less scale than 1/25,000.

(b) Fire must not be delivered over the heads of our own troops when the range to those troops exceeds 2,000 yards.

(c) It must be ensured that the bullets pass at a certain minimum height above the heads of the troops being fired over.

(d) Barrels and tripods must be in good order.

2. Clearance and minimum clearances

(a) "Clearance" at any point is the vertical height of the centre shot of the cone above that point. In accordance with rule (c) in para. 1, above, the minimum clearance for every range to our own troops has been calculated, and is laid down on pp. 2 and 3, range table. In these calculations allowances have been made with a sufficient safety margin on account of:—

(i) Permissible errors in range-taking (up to 5 per cent.).

(ii) Normal climatic variations.

(iii) Errors in sighting of guns.

(iv) Movement of the tripod in settling in during the first burst of fire, etc.

(v) The depth of the lowest shot of the cone below the centre shot.

(b) Influence of ground.

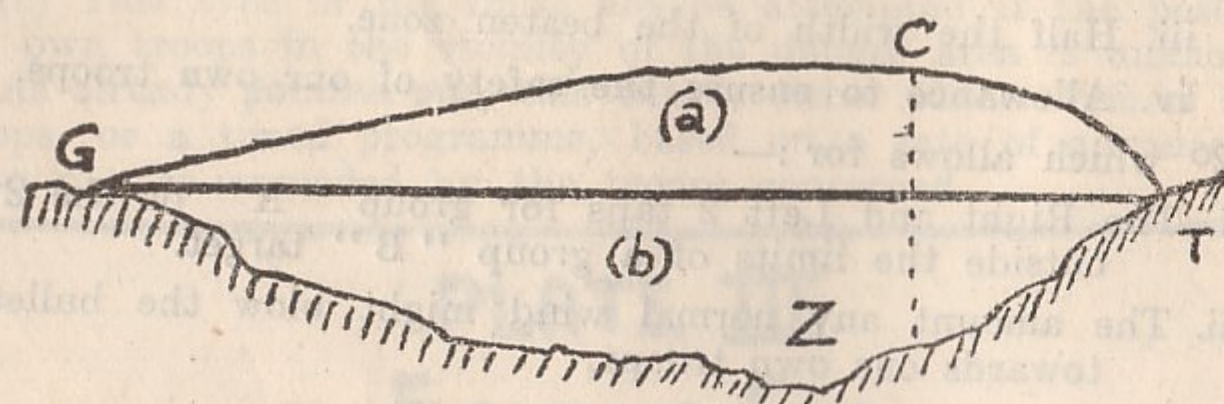


FIG. 16.

In Fig. 16, the cone at C is clearing troops at Z owing to two distinct factors:—

- (a) The natural curve of the trajectory above its line of sight.
- (b) The fact that the troops at Z are below the line of sight to the target.

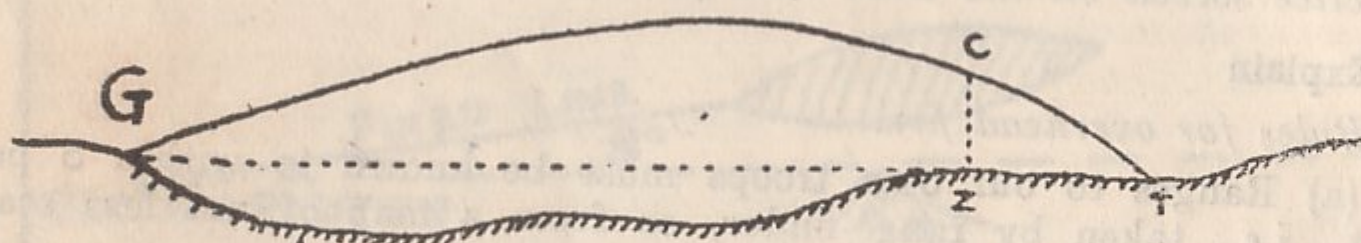


FIG. 17.

In Fig. 17, the cone at C is clearing troops at Z on account of the curve of the trajectory only. The problem to be solved in Figs. 16 and 17, before overhead fire can be opened, is whether the cone will clear the point Z by the minimum safety clearance.

3. The safety angle

The minimum clearance can also be expressed as an angle. Consider Fig. 18.

G is the gun.

GX the axis of the bore.

SZ the minimum clearance for our troops at Z.

Theoretically, there is only one position of the axis of the bore which will cause the centre shot to pass exactly through S. Suppose GX to be this position; any lower position would cause the trajectory to pass below S, and the necessary minimum clearance would not be given.

The angle XGZ is known as the safety angle for the range GZ, and is defined as the minimum angle which must be included between the axis of the bore and the line of sight to our own troops.

It can be easily calculated, as it can be seen that it is made up of the tangent angle for the range to our own troops (XGS) and the amount subtended by the minimum clearance at that range (SGZ). Safety angles are calculated for each range, and are laid down in the range table, pp. 2 and 3.

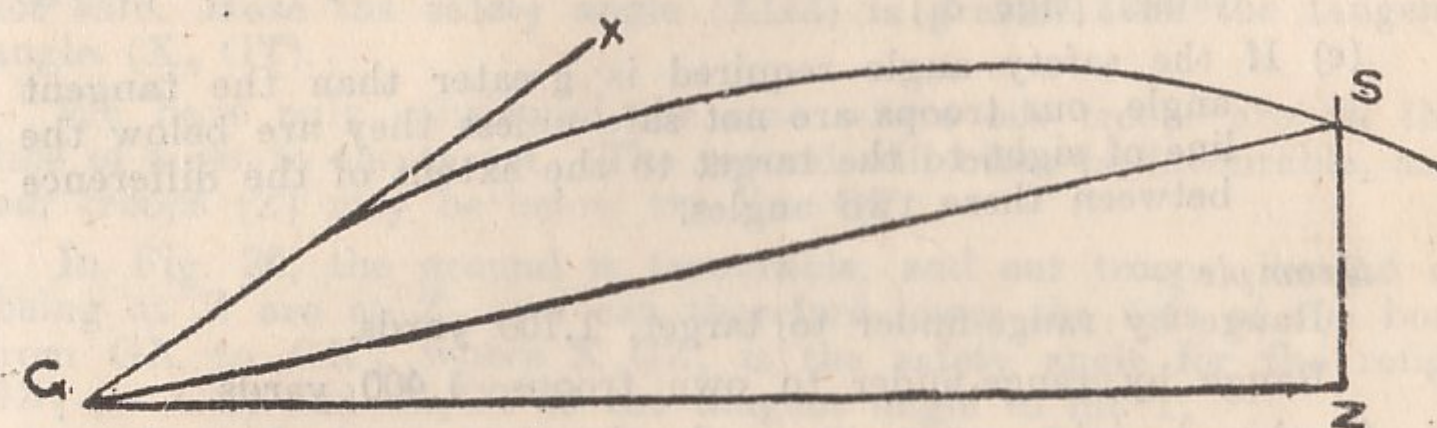


FIG. 18.

4. Control posts

These must be selected so that:—

- (a) They are not more than 6 feet above the guns.

If this is fulfilled, then the amount that the troops are below the line of sight to the target as measured from the control post can be taken as being the same as it is from the guns.

If the control post is more than 6 feet above the guns then the difference in the lines of sight to the troops and target as measured from the control post will NOT be the same as from the guns and therefore the slide rule will not give the true answer.

- (b) The target, guns and troops must be visible from the control post, for obvious reasons.

- (c) The range Control Post—Target and guns—target must not differ by more than 50 yards for the same reason as in (a) above.

5. Application of the safety angle

In order to decide whether our troops in a particular position are safe when a target is to be engaged, it is necessary to compare the safety angle for the range to our own troops with the tangent angle for the range to the target. If combined sights are used, the tangent angle for the lowest range must be compared. The procedure is governed by the following rules:—

- (a) If the safety angle required at the range to our own troops is less than lowest tangent angle to be employed, our troops are safe.

- (b) If the safety angle required is equal to the tangent angle, our troops are safe, provided they are not above the line of sight to the target.

Example :—

If our troops are advancing along the line of sight towards a target the range to which is given as 1,950 yards, fire must be stopped when they reach a point 1,500 yards from the gun, because the tangent angle for $1,900=3^{\circ} 47'$ the safety angle for 1,500 yards. (Range table, page 3.)

- (c) If the safety angle required is greater than the tangent angle, our troops are not safe unless they are below the line of sight to the target to the extent of the difference between these two angles.

Example :—

Range by range-finder to target, 1,700 yards.

Range by range-finder to own troops, 1,400 yards.

Combined sights must be used, therefore work from lowest elevation, i.e., 1,650.

Safety angle required for 1,400	$=3^{\circ} 24'$	Range table,
Tangent angle for 1,650	$=2^{\circ} 46'$	Page 3.

Difference $= 38'$

Therefore our troops must be 38' below the line of sight to the target to be safe.

The angle which our troops must be below the line of sight to the target to be safe can be measured from the gun position by means of the graticules in field-glasses, by any other accurate method of measuring vertical angles, or by the slide rule.

Theory of the rules for comparison of the safety angle with the tangent angle

In Fig. 19, G is the gun, Z our own troops, SZ the minimum clearance for the range GZ and T is the target.

Now if to hit T the axis of the bore were in a position GX and the centre shot passes through S, XGZ, the safety angle, is equal to the tangent angle to hit T, and our own troops are safe.

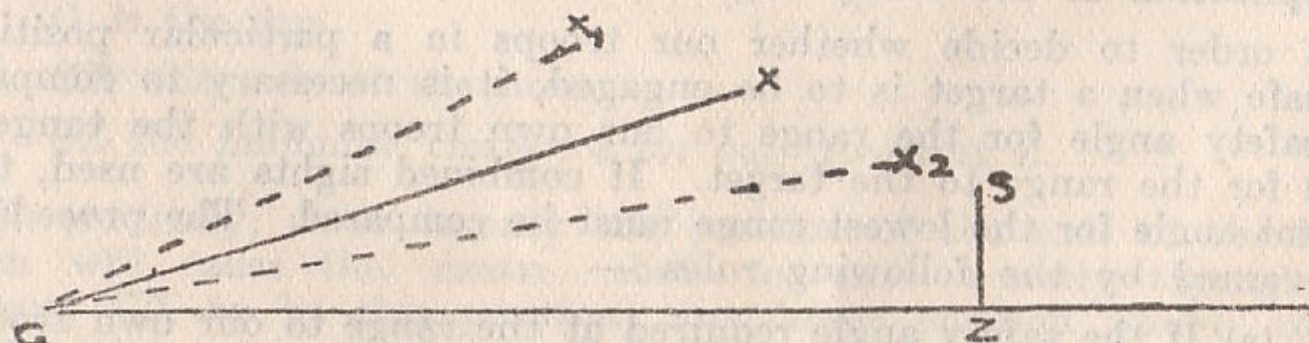


FIG. 19.

If to hit T the position of the axis of the bore were in a position GX_1 , the trajectory of the centre shot would pass above S and our troops are safe.

Hence we get the rule that if the safety angle (XGZ) is equal to, or less than, the tangent angle (X_1GT) our troops are safe provided they are not above the line of sight to the target.

If, however, to hit T the position of the axis of the bore were GX_2 , the trajectory would pass below S, and our troops at Z are not safe. Here the safety angle (XGZ) is greater than the tangent angle (X_2GT).

We have only considered the case where our troops are on the line of sight to the target. The ground will often be favourable, and our troops (Z) may be below the line GT.

In Fig. 20, the ground is favourable, and our troops, instead of being at Z are at Z_1 ; we can therefore lower the axis of the bore from GX to GX_1 where X_1GZ_1 is the safety angle for the range GZ_1 (or GZ) and X_1GT is the tangent angle to hit T.

Here it can be seen that the safety angle X_1GZ_1 is greater than the tangent angle (XGT) by the amount the ground has given us (ZGZ_1), and our troops are safe. The ground must give us this amount, or our troops would be unsafe.

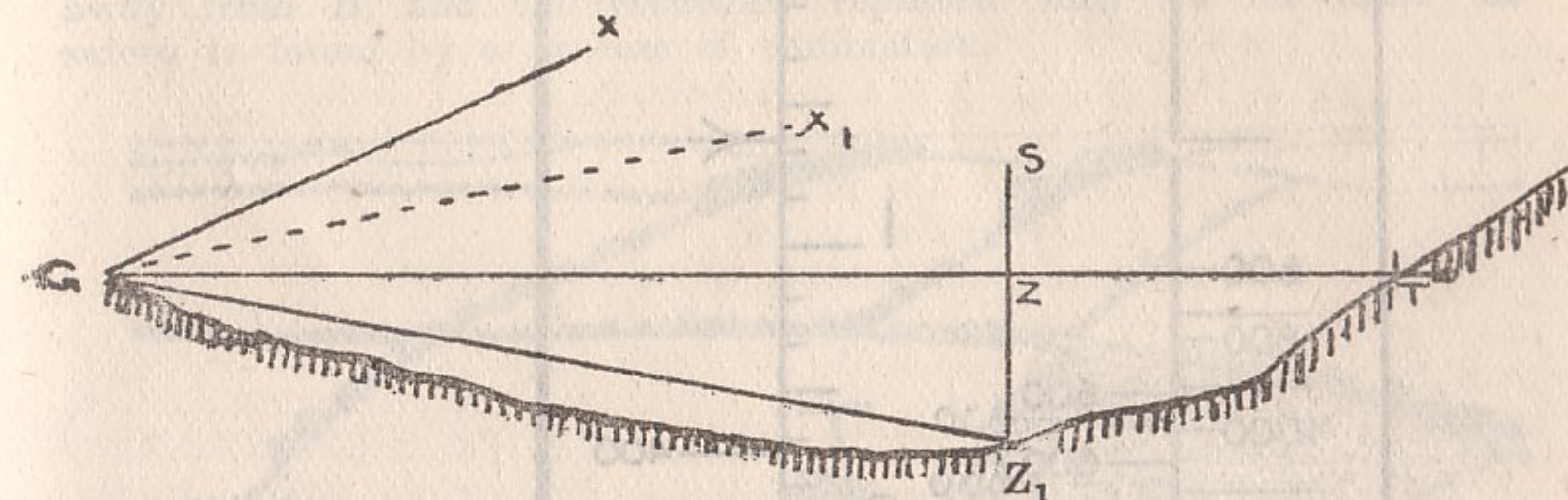


FIG. 20.

Hence we get the rule that if the safety angle for the range to own troops is greater than the lowest tangent angle used to engage the target; our troops will be safe if the angle between the line of sight to the target and the line of sight to our own troops is equal to, or greater than, the difference.

LESSON 68—USE OF THE SLIDE RULE IN OVERHEAD FIRE

Instructor's Notes

Stores.—Slide rules.

Method of instruction.—The various methods of applying the slide rule will be explained indoors and the class will then practise on the ground. The instructor setting practical problems.

1. Explain—The purpose of the slide rule

In order to save the labour entailed in comparing the tangent angles and safety angles, the Slide Rule is provided. (Lesson 92.)

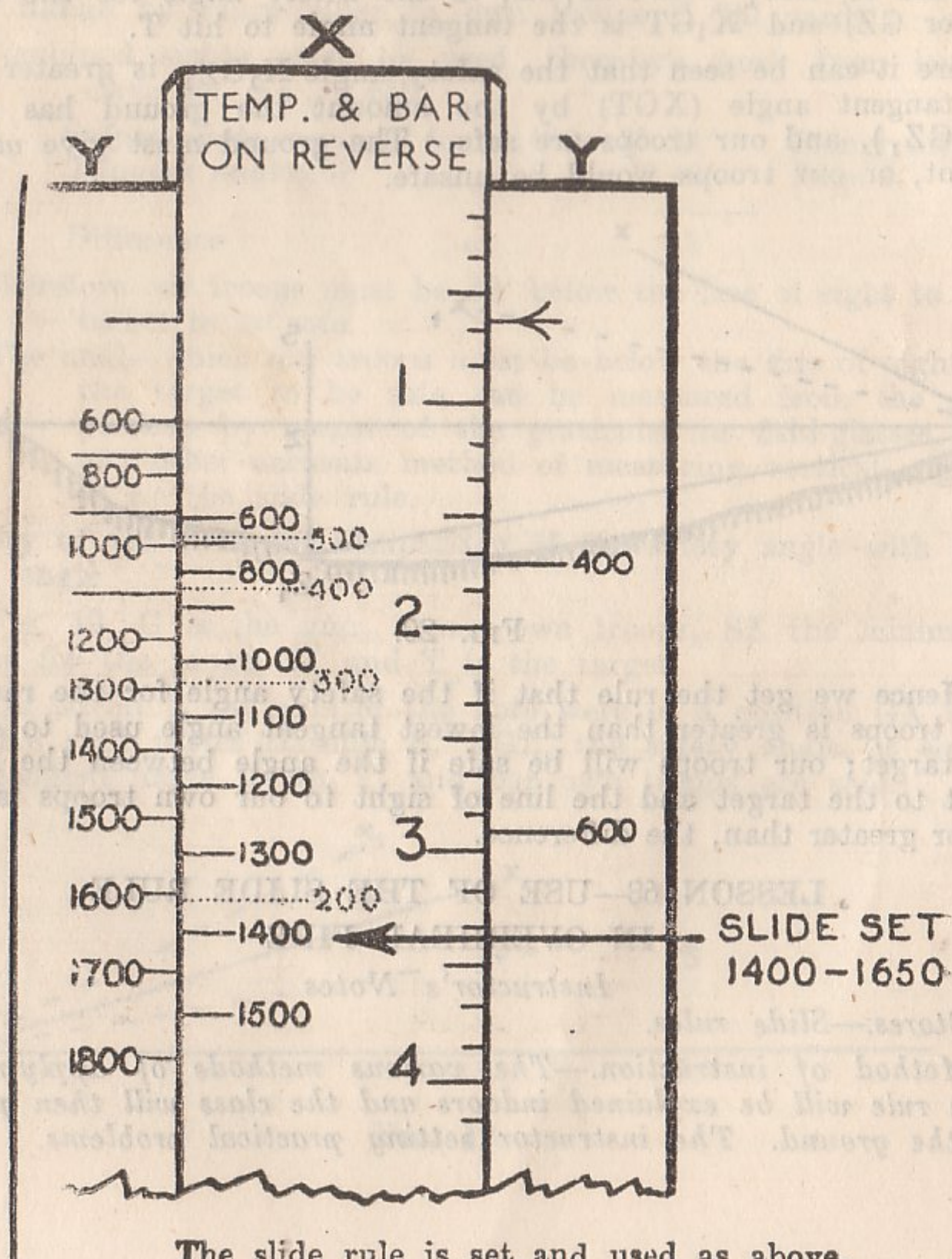
To use the slide rule in the case mentioned in the example in Lesson 67, 5(c), set 1,400 yards on the "Range to Own Troops" scale against 1,650 yards on the "Range to Target" scale. This will cause the slide to project above the top of the rule.

Hold the rule vertically at the full length of the string, bringing the shoulders at the top of the rule Y, in Fig. 21, along the line of our own troops nearest the target.

If the target can be seen above the top of the slide X, our troops are safe.

In effect, the height XY subtends at 24 inches from the eye the amount our troops must be below the line of sight to the target to be safe.

On the right side of the rule will be found a scale on which this amount is indicated when the slide rule is set.



The slide rule is set and used as above.

FIG. 21.

2. The practical use of the slide rule

The slide rule is employed in the following cases:—

(a) In the reconnaissance for a position from which to engage a definite target over the heads of our troops who are stationary, to determine whether fire can be opened with safety.

(b) To determine how near to a target our advancing troops can be supported by overhead fire with safety.

The nearest position of our troops to the target is known as the "far limit of safety" for that particular target.

The problem is solved by trial and error, using the slide rule as follows:—

The fire controller picks up a point (B) short of the target T (Fig. 22) up to which he estimates our troops could advance with safety. He orders his range-taker to take the range to this point and obtains the range to the target. He sets the slide rule as in para. 1, above, taking the range to B as the range to our own troops. If the projection XY (Fig. 21) does not fit in between the lines of sight to B and T, our fire must cease at some point nearer the gun than B. If it fits in with some amount to spare, then fire can be continued until our troops reach some point closer to T.

Another point is then selected for trial either nearer or further away from B, and the procedure repeated until the far limit of safety is found by a process of elimination.

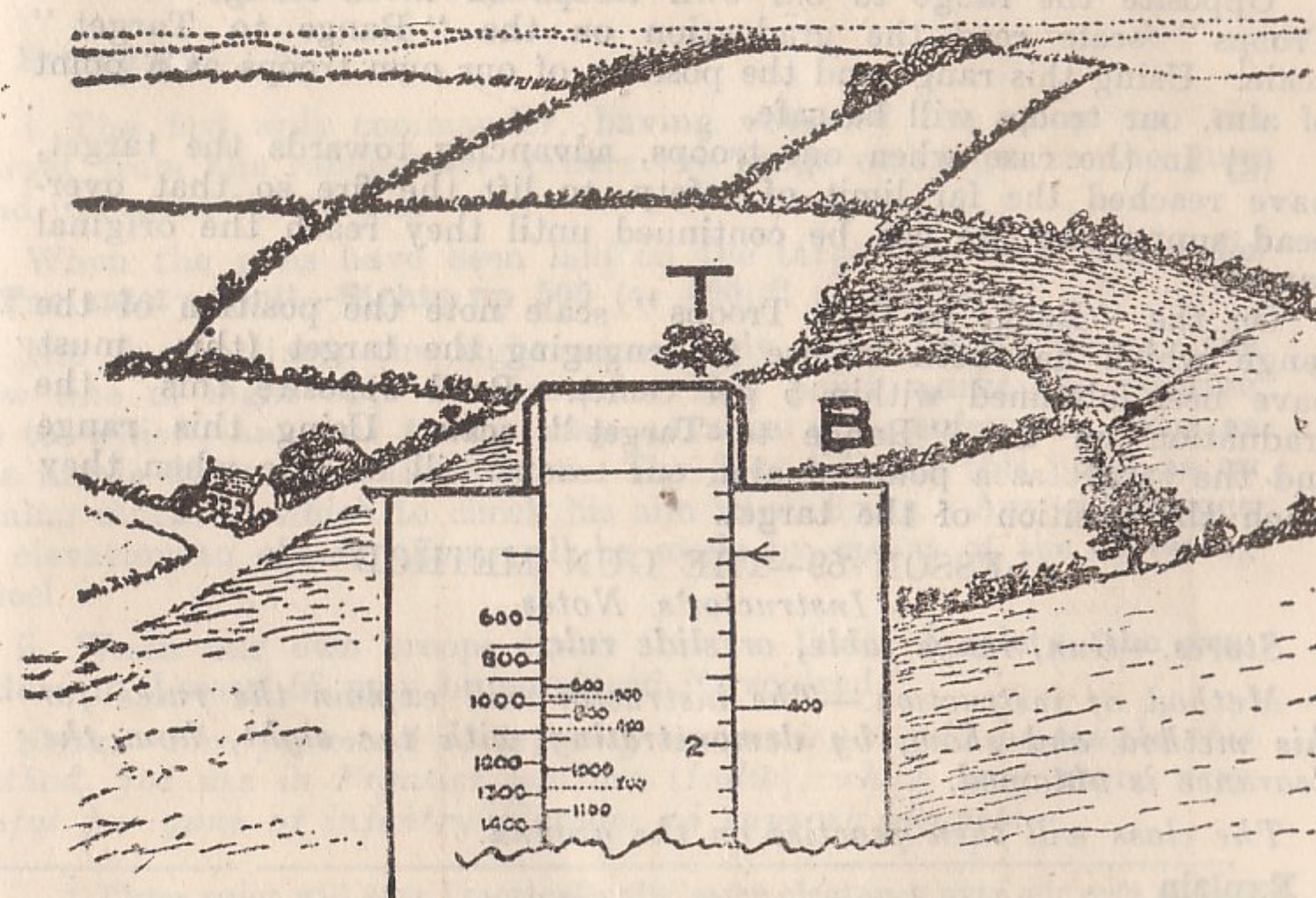


FIG. 22.

(c) To determine, when our troops are withdrawing, the line they must clear before fire can be opened on the ground evacuated by them.

Work out the far limit of safety as in (b) above, taking the ground on which fire is eventually required as the target.

(d) To determine, in the case of our troops advancing along the line of fire through the gun line, what line they must clear before fire can be opened.

This position is known as the "near limit of safety" for the particular target concerned.

Using the graduations marked in red on the "Range to Own Troops" scale, proceed as in (b) above.

In the following three cases the slide rule is set with the slide flush with the shoulders at the top of the rule.

(e) To determine the near and far limits of safety when our troops are on the line of the sight to the target.

Opposite the range to the target on the "Range to Target" scale read the graduations both on the red and the black scale on the slide. These graduations indicate the ranges to the near and the far limits of safety respectively.

The actual positions on the ground are found by trial and error.

(f) When our troops are stationary, to place overhead fire as close to them as possible.

Opposite the range to our own troops on the "Range to Own Troops" scale read the graduation on the "Range to Target" scale. Using this range and the position of our own troops as a point of aim, our troops will be safe.

(g) In the case when our troops, advancing towards the target, have reached the far limit of safety, to lift the fire so that overhead supporting fire can be continued until they reach the original target.

On the "Range to Own Troops" scale note the position of the range which has been in use for engaging the target (this must have been obtained within 5 per cent.). Read opposite this the graduation on the "Range to Target" scale. Using this range and the target as a point of aim, our troops will be safe when they reach the position of the target.

LESSON 69—THE GUN METHOD

Instructor's Notes

Stores.—Gun, range table, or slide rule.

Method of instruction.—The instructor will explain the rules for this method and show, by demonstrating with the sight, how the clearance is obtained.

The class will then practise on the ground.

1. Explain

i. This is a special method of covering advancing troops, only applicable when the ground at the target rises at a considerable

angle to the line of sight. It is ineffective on level ground. Its use, therefore, is confined to hilly country, such as is met with in mountain warfare operations.

ii. The principle underlying the method is that after the gun has been laid to hit the target by direct means, the sight is raised by an amount depending on the range to the target. The line of sight thus given will indicate the furthest point to which our troops can advance with safety.

iii. The rules for the employment of overhead fire by this method are :—

(a) The troops over whose heads the fire is being directed must be kept under observation.

(b) The range to our own troops must not exceed 2,000 yards.

(c) Barrels and tripods must be in good order.

(d) The range to the target must be known to within 5 per cent. of error or the target must have been previously registered.

(e) The range to the target must not be less than 700 yards.

(f) If the range to the target is between 700 and 1,200 yards, the sight will be set at 500 yards above the actual range.

If the range to the target is over 1,200 yards, the sight will be set at 400 yards above the actual range.*

2. Procedure

i. The fire unit commander, having obtained the range to the target from the range-taker, orders the range or ranges to the guns and indicates the target.

When the guns have been laid on the target, he will then order "**Far safety limit—Sights up 500 (or 400),**" as required.

The firer adjusts the sight accordingly and notes where the new line of sight cuts the ground. This point marks the position up to which our own troops may advance with safety, so long as the fire is directed at the target. The firer will use this point as an aiming mark on which to check his aim when firing. Any corrections in elevation to obtain effect will be made by means of the elevating wheel.

ii. When our own troops reach the far limit of safety, the procedure in Lesson 68 may be employed if required.

NOTE.—The personnel of infantry companies should be taught this method, for use in Frontier warfare (India), which may prove very useful for guns of infantry platoons to support picquets.

* These rules will give practically the same clearance over our own troops as demanded in range table, pp. 2 and 3. It must be realized that they only apply to troops approaching the target, and not those in close proximity to the guns.

SECTION 22—FIXED LINES FOR DEFENSIVE FIRE

1. Definition (see page 1).
2. Measures to maintain direction and elevation

- (a) The aiming peg.
- (b) The dial.
- (c) The clinometer.

Both (b) and (c) are additional measures so that if the aiming peg is knocked down or displaced the direction and elevation can be checked and the aiming peg replanted.

3. Pre-arranged area of ground

There are three situations to be considered:—

- (a) A pre-selected target such as a cross roads or clump of trees through which the enemy are likely to pass.
- (b) An area of ground such as a gap in some trees or a field in front of a wood. (See Plate IV.)
- (c) As close as possible to a defended locality.

4. Rules

- (a) Once the fixed line has been laid out, the tripod must NOT be moved.
- (b) The rules for flanking and overhead fire (Lessons 66 and 67) still hold good and must be applied.

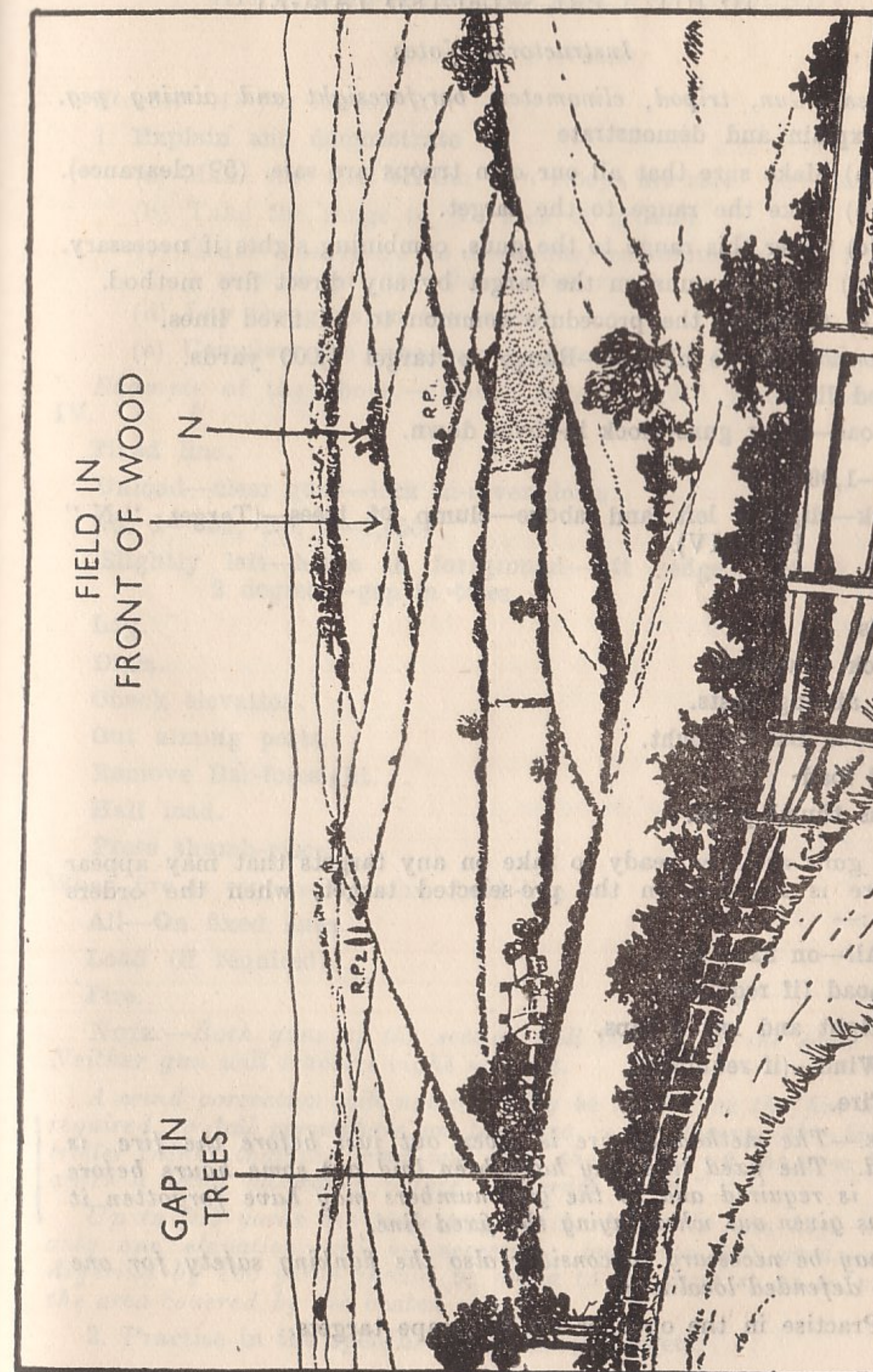
5. Procedure common to all fixed lines

- (a) Unload and clear the guns.
- (b) Lay the guns on their fixed lines by one of the methods given below.
- (c) Zero the dials.
- (d) Check the elevation on the guns.
- (e) Plant the aiming post.
- (f) Remove the bar-foresight.
- (g) Half load and press the thumb-piece.

When the fire is required, then order:—

- (h) All the guns to lay on their fixed lines.
- (i) Method of fire (if necessary).
- (j) Wind correction (if necessary).
- (k) The order to fire.

PLATE IV



LESSON 70—LAYING A FIXED LINE (FLANKING FIRE) TO HIT A PRE-SELECTED TARGET

Instructor's Notes

Stores.—Gun, tripod, clinometer, bar-foresight and aiming peg.

1. Explain and demonstrate

- Make sure that all our own troops are safe. (5° clearance).
- Take the range to the target.
- Order this range to the guns, combining sights if necessary.
- Lay the guns on the target by any direct fire method.
- Complete the procedure common to all fixed lines.

Example of the above:—Range to target 1,000 yards.

Fixed line.

Unload—clear guns—lock in-cover down.

All—1,000.

Stack—slightly left and above—clump of trees—(Target “N” Plate IV).

Lay.

Dials.

Check elevation.

Out aiming posts.

Remove Bar-foresight.

Half load.

Press thumb-piece.

The guns are now ready to take on any targets that may appear until fire is required on the pre-selected target, when the orders will be:—

All—on fixed lines.

Load (if required).

Right and left 2 taps.

Wind—(if required).

Fire.

NOTE.—The method of fire is given out just before the fire is required. The fixed line may have been laid out some hours before the fire is required and so the gun numbers may have forgotten it if it was given out when laying the fixed line.

It may be necessary to consider also the flanking safety for one or more defended localities.

2. Practise in the open or on landscape targets.

LESSON 71—LAYING A FIXED LINE (FLANKING FIRE) TO HIT A PRE-SELECTED AREA OF GROUND

Instructor's Notes

Stores.—As for Lesson 70.

1. Explain and demonstrate

- Make sure that all our own troops are safe. (5° clearance.)
- Take the range to the area of ground.
- Order this range to the guns, combining sights if necessary to prolong the beaten zones.
- Lay the guns on this area.
- Complete the procedure common to all fixed lines.

Example of the above.—(Range to area 1,010 yards.) See Plate IV.

Fixed line.

Unload—clear guns—lock in-cover down.

No. 1—950, No. 2—1,050.

Slightly left—house in foreground—left edge. Left 9 o'clock 2 degrees—gap in trees.

Lay.

Dials.

Check elevation.

Out aiming posts.

Remove Bar-foresight.

Half load.

Press thumb-piece.

When fire is required on this fixed line:—

All—On fixed lines.

Load (if required).

Fire.

NOTE.—Both guns of the section will be laid on the same point. Neither gun will traverse right nor left.

A wind correction will not normally be needed as the fire is only required to fall somewhere on the area. If however the fire controller thinks that the wind will blow the bullets off the area he can order a wind allowance before the order “fire”.

Up to 800 yards the trajectory of the bullet is man high and so only one elevation will be necessary, but over 800 yards ranges differing by 100 yards should be given to the guns so as to prolong the area covered by the beaten zones.

2. Practise in the open or on landscape targets.

LESSON 72—LAYING A FIXED LINE (FLANKING FIRE) AS NEAR AS POSSIBLE TO A DEFENDED LOCALITY

Instructor's Notes

Stores.—As for Lesson 70.

1. Explain and demonstrate

- Choose a point on the forward edge of the locality to be defended, and take the range to this point.
- Order this range to the guns, combining sights if necessary to prolong the beaten zone. (See note on this in Lesson 71.)
- Lay the guns on this point
- By means of the bar-foresight lay the guns 3° to the flank of the defended locality.
- Complete the procedure common to all fixed lines.

Example of the above. (Range to selected point 980 yards.)

Fixed line.

Unload—clear guns—lock in-cover down.

No. 1—950, No. 2—1,050.

Slightly left—house—Right edge.

Lay.

Affix Bar-foresight.

Realign line of sight on house.

All right 3° degrees.

Dials.

Check elevation.

Out aiming posts.

Remove Bar-foresight.

Half load.

Press thumb-piece.

When fire is required on this fixed line:—

All—on fixed lines.

Load (if required).

Fire.

NOTE.—Both guns of the section will now be laid on the same place. Neither gun will traverse right nor left.

2. Practise in the open or on landscape targets.

LESSON 73—LAYING A FIXED LINE (OVERHEAD FIRE) TO HIT A PRE-SELECTED TARGET

Instructor's Notes

Stores.—Gun, tripod, clinometer, bar-foresight, aiming peg, slide rule and range tables

1. Explain and demonstrate

- Take the range to the target and own troops and ascertain that the troops will be safe when using the lowest elevation required to hit the target.
- Order the range to the target to the guns, combining sights if necessary.
- Lay the guns on the target.
- Complete the procedure common to all fixed lines.

Example of the above. Range to target 1,845 yards, range to own troops 1,420. Difference in lines of sight $30'$.

Fixed lines.

Unload—clear guns—lock in-cover down.

No. 1—1,800, No. 2—1,900.

Poplar—right 2 o'clock 2 degrees—clump of bushes to right of Church.

Lay.

Dials.

Check elevation.

Out aiming posts.

Remove Bar-foresight.

Half load.

Press thumb-piece.

When fire is required on this fixed line:—

All—on fixed lines.

Load (if necessary).

Right and left 2 taps.

Wind (if required).

Fire.

2. Practise in the open or on landscape targets.

LESSON 74—LAYING A FIXED LINE (OVERHEAD FIRE)
SO AS TO PUT A BELT OF FIRE ON A PRE-SELECTED
AREA OF GROUND, EACH GUN COVERING
ABOUT 25 YARDS OF FRONT

Instructor's Notes

Stores.—As for Lesson 73.

1. Explain and demonstrate

- Take the range to the area and to own troops and ascertain that the troops will be safe.
- Order the range to the area to the guns. (Do not combine sights.)
- Lay the guns on two points about 1° apart.
- Complete the procedure common to all fixed lines.

Example of the above. Range to area 1,515 yards, range to troops 985 yards. Difference in angle of sight $15'$.

Fixed lines.

Unload—clear gun—lock in-cover down.

All—1,500.

Poplar.

Lay.

No. 1—Right 3° —No. 2—Right 2° .

Dials.

Check elevation.

Out aiming posts.

Remove Bar-foresight.

Half load.

Press thumb-piece.

When fire is required on this fixed line:—

All—on fixed lines.

Load (if necessary).

Right and left 2 taps.

Fire.

NOTES.—(i) If there had been two objects about 1° apart which could have been indicated, the guns could have been laid on them, e.g., Poplar—right 4 o'clock 4 degrees—bush—No. 1—Lay—Bush—Left 9 o'clock—where hedgerow disappears—No. 2—Lay.

(ii) By laying the guns 1° apart and traversing right and left 2 taps, the section will cover approximately 50 yards.

(iii) No wind allowance is required as it does not matter if the bullets fall slightly to the right or left, all that is needed is to put down a belt of fire across the preselected area of ground.

2. Practise in the open or on landscape targets.

LESSON 75—LAYING A FIXED LINE (OVERHEAD FIRE)
AS NEAR AS IS SAFE TO A DEFENDED LOCALITY,
EACH GUN COVERING ABOUT 25 YARDS
OF FRONT

Instructor's Notes

Stores.—As for Lesson 73.

1. Explain and demonstrate

- Obtain the range by range-finder to the forward edge of the defended locality.
- From the slide rule or range tables ascertain the minimum range which will ensure the safety of the troops in the defended locality.
- Order this safe range to the guns.
- Lay the guns on two points on the forward edge of the locality which are about 1° apart.
- Complete the procedure common to all fixed lines.

Example of the above. Range to forward edge of own troops 1,510 yards.

Fixed lines.

Unload—clear guns—lock in-cover down.

All—1,950.

Stack—Slightly left and above—clump of trees—left edge—
No. 1—Lay—clump of trees—left 1 degree—junction of
hedgerows—No. 2—Lay.

Dials.

Check elevation.

Out aiming posts.

Remove Bar-foresight.

Half load.

Press thumb-piece.

When fire is required on this fixed line:—

All—on fixed lines.

Load (if necessary).

Right and left 2 taps.

Fire.

NOTES.—(i) No lifts are necessary.

(ii) No correction for wind is required as it does not matter if the bullets fall slightly to the right or left, all that is needed is to put down a belt of fire as close as possible to the defended locality.

2. Practise in the open or on landscape targets.

SECTION 23—INDIRECT FIRE

The opening of fire rapidly and effectively by indirect means depends on accuracy in the use of the various instruments and minute precision in drill. This can only be attained by a high standard of training and frequent practice.

LESSON 76—GENERAL PRINCIPLES

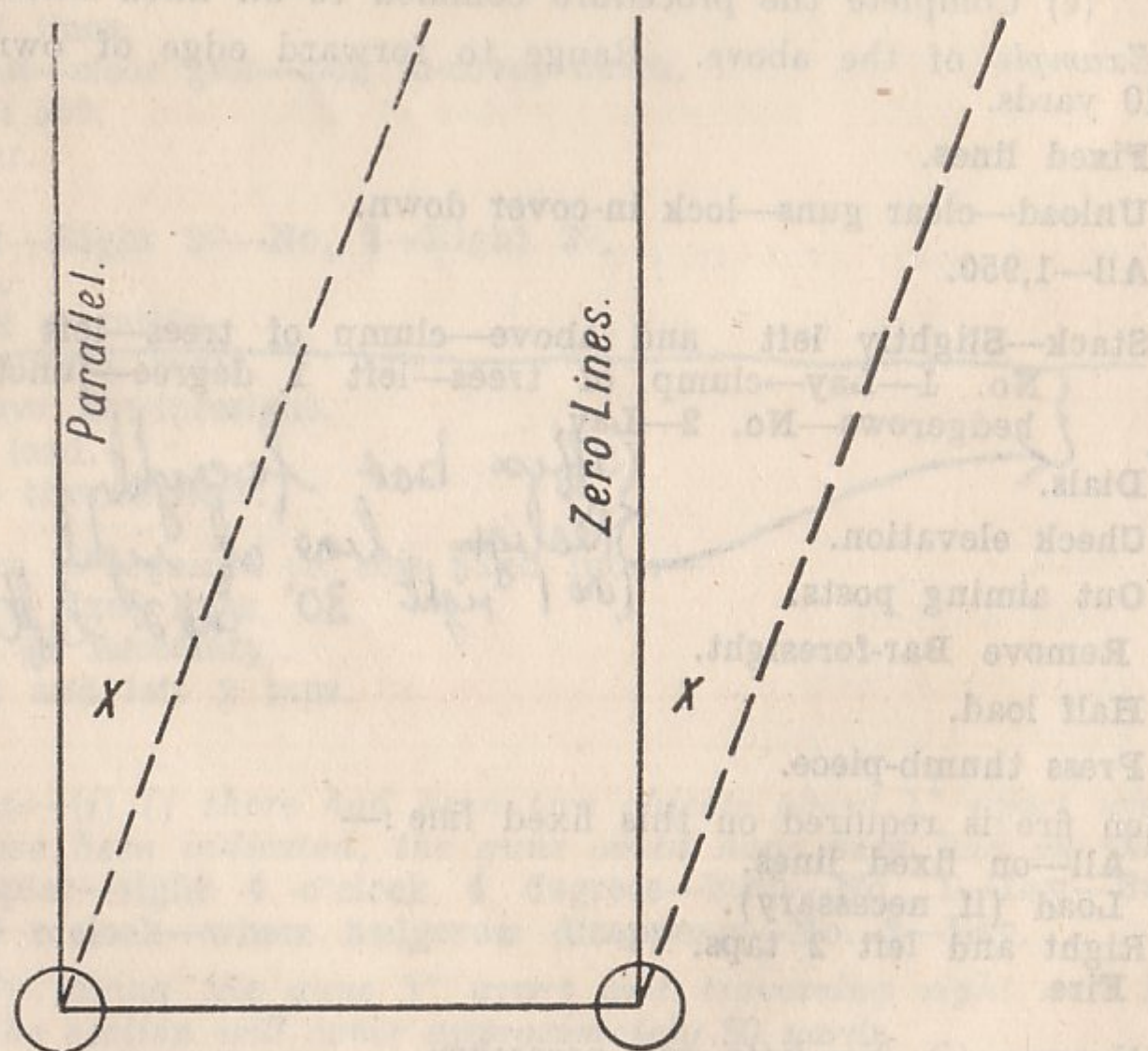
Instructor's Notes

Stores.—Blackboard.

Explain**1. Zero Lines**

Lines which are parallel, when swung through the same angle remain parallel.

Therefore to provide a basis from which fire can be switched in any direction guns are initially placed on parallel zero lines.



X = an angle of switch.

FIG. 23.

The direction of the zero lines is normally the first target.

2. Gun Frontage

Normally 30 yards: guns on parallel lines cover a width on the target equal to the gun frontage.

3. Method of laying

- Direction—by means of a visible aiming point in direct alignment with the target.
- Elevation—as a quadrant angle put on by means of a clinometer.
- Direction and elevation are maintained by an aiming mark.

4. Errors in range and direction

Errors in range are allowed for by applying the principles underlying the Combined Sight Rule, as in Direct Fire. Lifts will be given in minutes.

To allow for errors in direction and to cover the gaps between the guns the method of fire will be right and left 2 taps. Targets wider than the gun frontage are engaged by switching.

5. Methods of giving the original line

One gun, termed the pivot gun, is aligned on the correct position on the Target for that gun by one of the following methods:—

(a) The Crest Method (Lesson 80).

(b) The Peg Method (Lesson 81).

The other gun is placed on parallel lines to it as described in Lesson 82.

6. Elevation is obtained by a combination of the tangent angle for the range to the target, *plus* or *minus* the angle of sight.

7. The following lessons deal with the above methods. The details of the necessary Fire Orders are given in Lesson 78 and Section 24, and the procedure is given in Section Drill—Indirect Fire, Section 14.

LESSON 77—OBTAINING ELEVATION

Instructor's Notes

Stores.—Blackboard, range tables, directors.

Method of instruction.—The procedure will be explained indoors. The squad will be practised with examples and the instruction completed out of doors on various types of targets.

Explain

The elevation is obtained by one of the processes given below:—

- When the angle of sight to the target can be taken from a position which is within 6 ft. in height of the gun position, and which is not more than 150 yards distant from it.

Measure the angle of sight to the target by means of the director. For all practical purposes this can be taken as being the angle of sight from the gun position.

Correct the range given by the range-taker by the amount his instrument was in front of, or behind, the guns.

The elevation will be given to the guns as a range \pm the angle of sight.

(b) When the angle of sight to the target cannot be taken from a position within 6 ft. in height of the gun position one of the following methods may be employed. Both entail measuring the angle of sight from the observation post to the target and to the gun position:—

(i) Using the range O.P. to target and the angle of sight to the target, obtain from the V.I. table or slide rule the height the target is above or below the O.P.

Obtain the distance O.P.—gun position by pacing, estimation or range-taker, and using the angle of sight to the gun position, obtain from the V.I. table or slide rule the height the gun position is below or above the O.P.

A comparison of the heights of the gun position and target above or below the O.P. will give the height the target is above or below the gun position.

Convert this from the V.I. table or slide rule to an angle of sight.

Example :—

Angle of sight from O.P. to target—Depression 22'.

Angle of sight from O.P. to gun position—Depression 2° 20'.

Range O.P.—target, 1,700 yards.

Distance O.P.—gun position, 80 yards.

Range gun position—target 1,750 yards.

Target is below O.P.—11 yards. (The amount subtended by 22 at 1,700 yards.)

Gun position is below O.P.—3 yards. (The amount subtended by 2° 20' at 80 yards.)

Therefore target is below gun position 8 yards.

From V.I. table or slide rule angle of sight (8 yards at 1,750 yards)=depression 16'.

(ii) Find the height that the target is above or below the guns as in (i) above.

From the graph on page 15 of the range tables, against the amount the target is above or below the guns and under the range required, read the necessary Q.A.

LESSON 78—FIRE ORDERS—INDIRECT

Instructor's Notes

Stores.—Blackboard, range tables.

The lesson should be carried out in the form of a lecture.

1. Explain

The sequence of an Indirect Fire Order will be :—

- (a) Elevation (or elevations).
- (b) Crest clearance drill (N.C.O. i/c guns).
- (c) Out aiming posts (or Pick-up gun aiming marks).
- (d) Guns ready to load (N.C.O. i/c guns).
- (e) Load.
- (f) Method of fire.
- (g) Side wind allowance.
- (h) Rate of fire (if Rapid).
- (i) Order to fire.

2. Notes on the above orders

(a) Elevation (Lesson 77)—

(i) Preceded by "Elevation All (or No. 1, etc.)"

(ii) Angles given to the nearest 5 minutes.

(d) Guns ready to load.

The N.C.O. i/c guns will not report until he has satisfied himself that the Nos. 3 have come back behind the guns.

(f) Method of fire.

Ordered as :—

"Right and left 2 taps."

(g) Side wind allowance.

(i) Preceded by "Wind" and ordered in degrees and minutes to the nearest 5 minutes.

(ii) The allowance ordered will be placed on the bar-foresight.

(iii) When the wind deflection ordered has been placed on the bar-foresight No. 1 will tap the gun over until he has a correct aim on the aiming post over the blade of the bar-foresight.

3. Orders during a shoot

(a) *Lifts.*

Given in minutes which will be determined from the range table, pages 2 and 3, col. 3, and given in the form—

"All—up . . . mins."

This order may be given verbally or by signal as detailed in sub-para. (b) (ii) below.

(b) *Ranging corrections.*

(i) *Direction.*

The amount of switch required is measured by the director, glasses, or by slide rule according to the time available.

The correction may be given verbally, or the following semaphore signals may be employed:—

T . . . right 30'.

L . . . left 30'.

To double or increase further the corrections, the code letter will be repeated as necessary.

(ii) *Elevation.*

The fire controller estimates the correction required in hundreds of yards, and orders the result in minutes:—

All—up (or down).....minutes.

This order may be sent by semaphore signal as follows:—

U . . . up 10'.

N . . . down 10'.

To double or increase further the correction, the code letter will be repeated as necessary.

If during the shoot it is seen that any gun or guns are firing over or short as compared with the remainder, the order "**check elevation**" will be given.

LESSON 79—METHOD OF ENGAGING TARGETS— INDIRECT FIRE

Instructor's Notes

Stores.—Blackboard, range tables and slide rules.

The subject-matter will be given in the form of a lecture.

1. Classification of targets.

(a) Smaller than or equal to the gun frontage with or without depth.

(b) Greater than the gun frontage with or without depth.

2. Methods of engaging—

(a) *Direction:—*

(i) Targets smaller than or equal to the gun frontage. Lay the guns on parallel lines astride the target.

(ii) Targets greater than the gun frontage. Lay the guns on parallel lines with the pivot gun on its flank of the target. When this portion of the target has been

engaged switch the guns over by the amount that the gun frontage subtends at the range to the target.

(b) **Elevation—**

(i) Targets without depth—

Start with all guns on the lower Q.A. required (if range calls for combined sights) and give a lift equivalent to 100 yards in minutes.

(ii) When the target has depth—

Start with all guns on the lowest Q.A. required to engage the near end and the lift in the equivalent of 100 yards in minutes until the highest elevation required to hit the far end is reached. If the difference in angle of sight is greater than 20' then an extra one or the lifts of 100 yards in minutes must be given.

For examples of indirect fire orders, see Section 24.

LESSON 80—THE CREST METHOD

Instructor's Notes

Stores.—Two guns and tripods, and indirect fire equipment.

Method of instruction.—The theory will be explained indoors and the Instructor will then give practice out of doors.

1. Explain

This method can be used when the guns are in action just behind the crest, and the target, although not visible from gun height, can be seen by the fire controller or N.C.O. i/c gun line, from any position directly behind the guns up to about 25 yards back.

2. Procedure

When the guns have been mounted, the fire controller or N.C.O. i/c gun line, stands or kneels behind the pivot gun at a convenient distance away. He orders the No. 1 to lean his head aside. He then orders him to tap the gun right or left until it is laid on its correct position on the target. (See Lesson 46.)

LESSON 81—THE PEG METHOD

Instructor's Notes

Stores.—Two guns and tripods, indirect fire equipment, four pegs, blackboard.

Method of instruction.—As for Lesson 80.

1. Procedure

Two or more pegs are aligned on the correct portion of the target for the pivot gun.

They will be placed so that the line joining them passes over the position chosen for the pivot gun. (Fig. 24.) Both pegs, or any two if more than two have been used, must be visible from this position at gun height.

When the guns are brought up, the pivot gun is mounted in direct alignment with the pegs and laid on them.

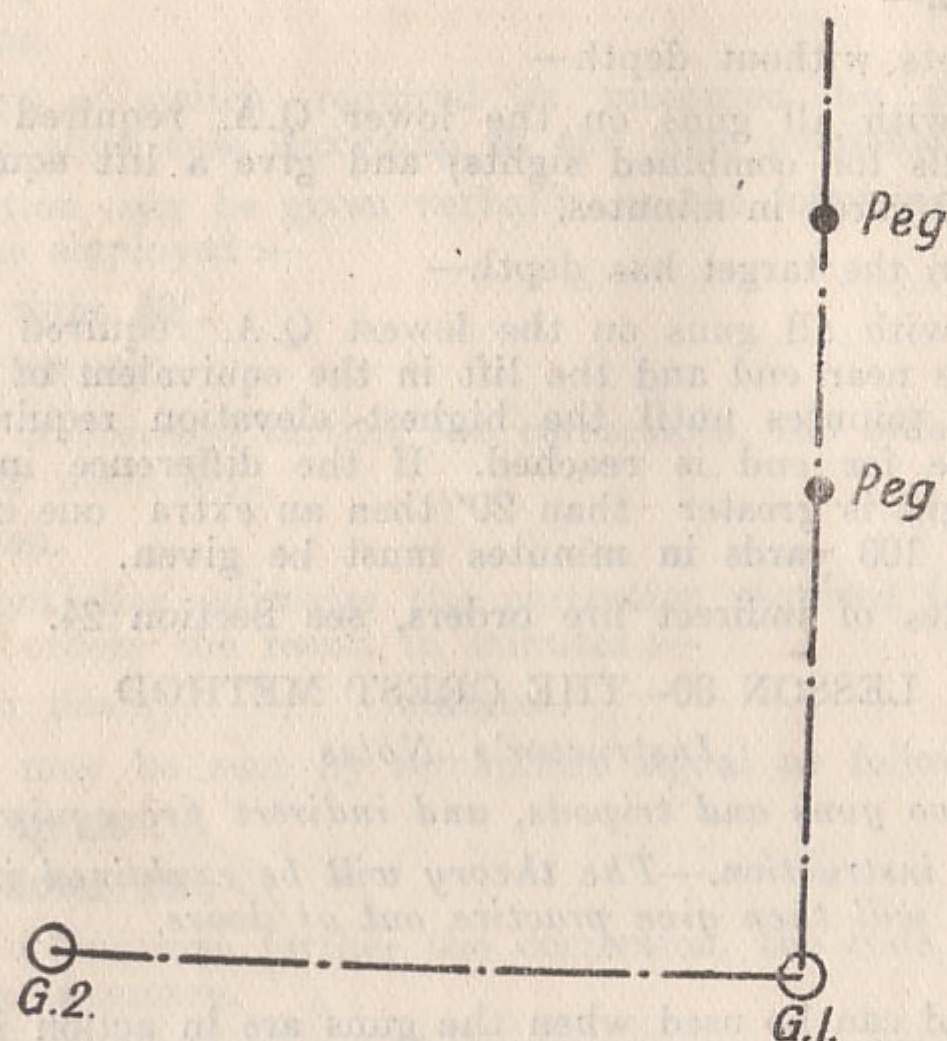


FIG. 24.

LESSON 82—METHOD OF PARALLELING THE GUNS

Instructor's Notes

Stores.—Blackboard, two guns with tripods, two pegs and indirect fire equipment.

Method of Instruction.—The theory will be explained indoors and the instructor will then give individual practice out of doors.

Procedure—(When No. 1 gun is the pivot gun).

- (i) The Pivot gun is aligned on the correct position on the Target for that gun.
- (ii) The dial of the pivot gun is set at 180° .
- (iii) No. 2 gun lays on the centre of the socket of the pivot gun and its dial is set at 0° .
- (iv) The pivot gun then swings round and lays on the centre of the socket of No. 2 gun. The angle against the pointer on the dial is read off and given to No. 2 gun.
- (v) No. 2 gun is then swung through this angle and is then on a zero line parallel to that of the pivot gun.

NOTE.—When reading the dial of the pivot gun the direction (right or left) is reversed before the angle is given out to the other gun.

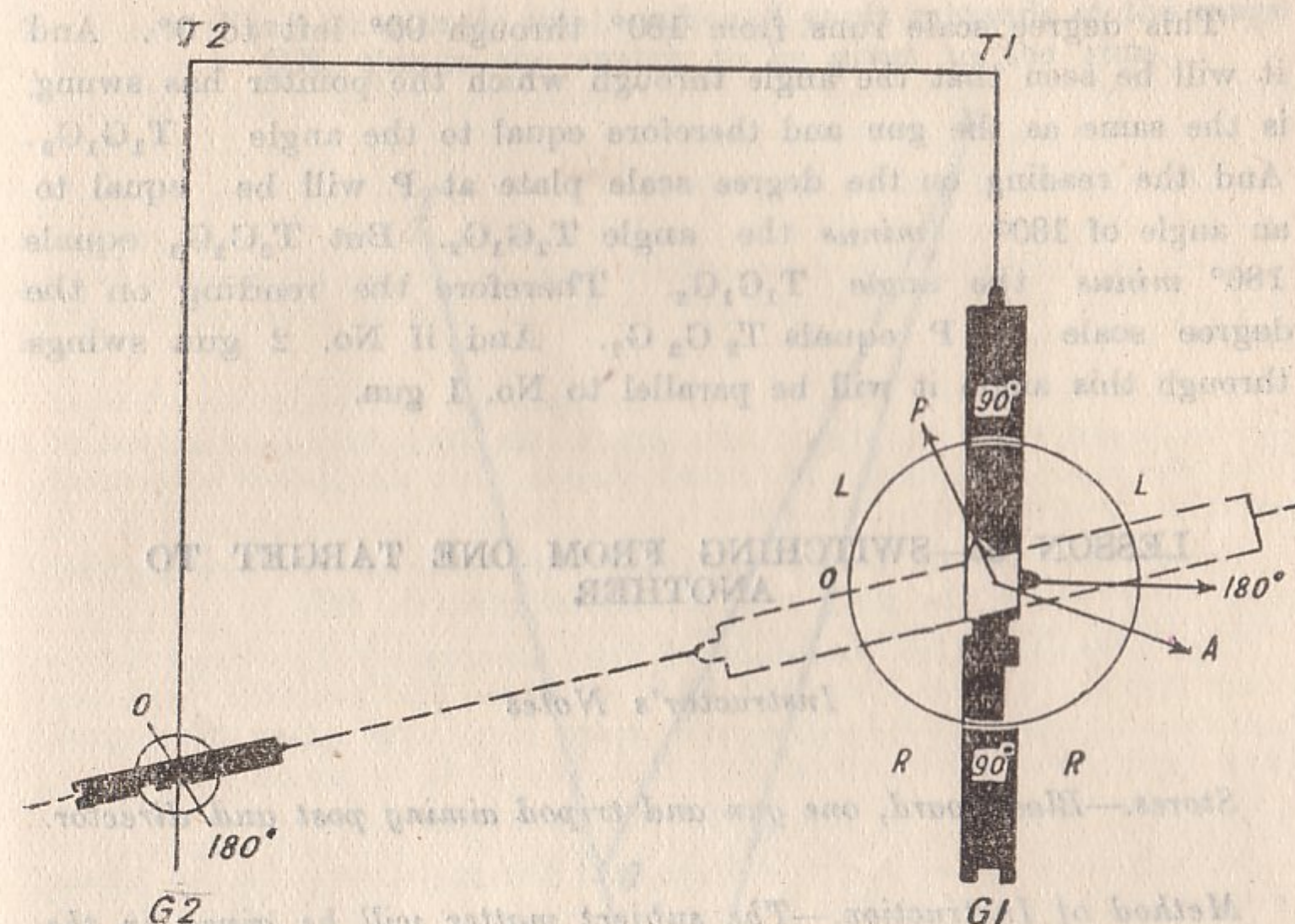


FIG. 25.

Theory

G_1 is the pivot gun and has been laid on the right end of the Target T_1T_2 . G_1G_2 is the line joining No. 1 Gun to No. 2 Gun. It is desired to place G_2T_2 parallel to G_1T_1 .

If the angle $T_1G_1G_2$ plus the angle $T_2G_2G_1$ equals 180° , then G_2T_2 will be parallel to G_1T_1 and therefore the angle $T_1G_1G_2$ will equal 180° minus the angle $T_2G_2G_1$.

The position of No. 1 Gun when it is laid on the right end of the target is shown in black. Its dial is set so that 180° on the degree scale is opposite the pointer (A) which is attached to the crosshead of the gun.

When the gun is swung round and laid on No. 2 Gun, it will be in the dotted position and the pointer will have moved round from 180° to a position P on the degree scale.

This degree scale runs from 180° through 90° left to 0° . And it will be seen that the angle through which the pointer has swung is the same as the gun and therefore equal to the angle $T_1G_1G_2$. And the reading on the degree scale plate at P will be equal to an angle of 180° minus the angle $T_1G_1G_2$. But $T_2G_2G_1$ equals 180° minus the angle $T_1G_1G_2$. Therefore the reading on the degree scale at P equals $T_2G_2G_1$. And if No. 2 gun swings through this angle it will be parallel to No. 1 gun.

LESSON 83—SWITCHING FROM ONE TARGET TO ANOTHER

Instructor's Notes

Stores.—Blackboard, one gun and tripod aiming post and director.

Method of Instruction.—The subject matter will be given in the form of a lecture and the instructor will then give individual practice out of doors.

The angle of switch may be measured with a director, field glasses or a slide rule. The position from which it is measured must be within the parallel lines of the guns, either forward or behind the gun line.

When the angle of switch is measured from a position not more than 50X from the guns, the angle obtained will be, for all practical purposes, sufficiently accurate, and this angle will be given to the guns.

When, however, the angle is measured from a position more than 50X from the gun, it will not be sufficiently accurate and therefore the following calculation must be made:—

(a) Measure the angle TOX (where X equals the new target).

(b) Find the number of yards this subtends at the range OX.

(c) Find what angle this number of yards subtends at the range GX, this is the switch to be given to the guns.

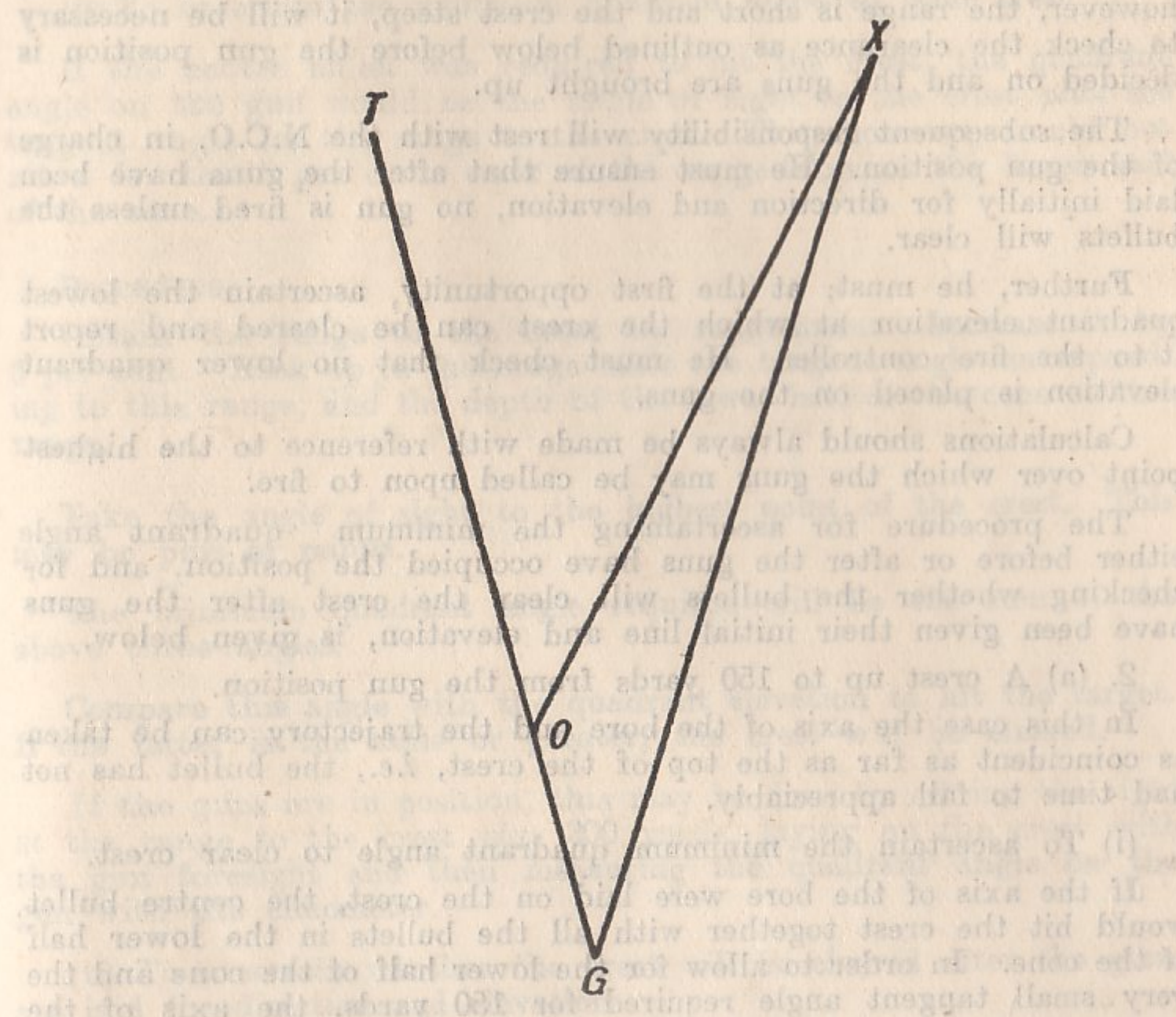


FIG. 26

LESSON 84—CREST CLEARANCE

Instructor's Notes

Stores.—Blackboard, range table, director, gun, tripod and clinometer.

Method of instruction:—The procedure will be explained indoors. The squad will be practised with examples and instructions completed out of doors on various types of targets.

1. Explain

The initial responsibility for determining whether the bullets will clear the crest in front of the guns rests with the fire controller. He must ensure that, when he chooses the gun position, clearance exists for the target or targets he intends to engage.

It will not always be necessary or practicable to resort to measurement by instruments and calculation of crest clearance during the reconnaissance for the gun position. With practice it

may often be possible to judge how far back the gun position can be situated without risk of the bullets striking the crest. If, however, the range is short and the crest steep, it will be necessary to check the clearance as outlined below before the gun position is decided on and the guns are brought up.

The subsequent responsibility will rest with the N.C.O. in charge of the gun position. He must ensure that after the guns have been laid initially for direction and elevation, no gun is fired unless the bullets will clear.

Further, he must, at the first opportunity, ascertain the lowest quadrant elevation at which the crest can be cleared and report it to the fire controller. He must check that no lower quadrant elevation is placed on the guns.

Calculations should always be made with reference to the highest point over which the guns may be called upon to fire.

The procedure for ascertaining the minimum quadrant angle either before or after the guns have occupied the position, and for checking whether the bullets will clear the crest after the guns have been given their initial line and elevation, is given below.

2. (a) A crest up to 150 yards from the gun position.

In this case the axis of the bore and the trajectory can be taken as coincident as far as the top of the crest, i.e., the bullet has not had time to fall appreciably.

(i) To ascertain the minimum quadrant angle to clear crest.

If the axis of the bore were laid on the crest, the centre bullet would hit the crest together with all the bullets in the lower half of the cone. In order to allow for the lower half of the cone and the very small tangent angle required for 150 yards, the axis of the bore must be laid at least 15' above the crest.

Procedure

Set the director up at gun height and measure the angle of sight to the highest part of the crest. To this angle add 15' to allow for the lower half of the cone, etc. Compare this angle with the quadrant elevation to hit the target. If the latter is the same or greater, the crest will be cleared.

If the guns are in position, this may be done by setting the sight at 400, laying on the crest and then measuring the quadrant angle with the clinometer.

(ii) To ascertain after the guns have been laid for elevation and direction whether the crest will be cleared.

Set the sight at 400 yards. If the line of sight clears the crest the bullets will clear.

This will allow for the lower half of the cone and the fact that the line of sight with the sights at zero is slightly above the barrel.

(b) A crest more distant than 150 yards from the gun position.

(i) To ascertain the minimum quadrant angle to clear crest.

If the centre bullet was required to hit the crest, the quadrant angle on the gun would be the angle of sight to the crest *plus* the tangent angle for the range to the crest. This, however, would not allow for the 5 per cent. error of the range-taker or the lower half of the cone.

Procedure

Obtain the range to the crest by range-finder. Increase it by 5 per cent. Look up in the range table the tangent angle corresponding to this range, and the depth of the lower half of the cone at this range.

Take the angle of sight to the highest point of the crest. This may be plus or minus.

The minimum quadrant angle required will be the sum of the above three angles.

Compare this angle with the quadrant elevation to hit the target. If the latter is the same or greater, the crest will be cleared.

If the guns are in position, this may be done by setting the sight at the range to the crest *plus* 200 yards, laying on the crest with the gun foresight and then measuring the quadrant angle on the gun with the clinometer.

(ii) To ascertain whether the crest will be cleared after the guns are laid for direction and elevation.

Add 200 yards to the range obtained by the range-finder to the crest, place the resultant range on the sight, and see whether the line of sight clears. This 200 yards allows for 5 per cent. range-taking error in addition to lower half of the cone.

LESSON 85—OVERHEAD FIRE WHEN FIRING INDIRECT

Instructor's Notes

Stores.—Slide rules, range tables and director.

Method of instruction.—The various methods will be explained indoors and the class will then practise on the ground. The instructor setting practical problems.

Explain

(a) The fire controller is responsible for selecting the gun position so that targets can be engaged without endangering our own troops.

(b) The Rules for Overhead Fire when firing direct (Lesson 67) apply equally to indirect fire. The O. P. must conform to the same conditions laid down for control posts. If the O. P. is more than 6 feet above the guns, then overhead fire cannot be given.

(c) The problem can now be worked out in two ways:—

(i) By using the slide rule exactly the same way as for direct fire. (Lesson 68.)

(ii) By comparing the safety angle for the range guns-troops *plus* or *minus* the angle of sight to the troops, according to whether the angle of sight to them is one of elevation or depression, with the lowest quadrant elevation required to hit the target. If the latter is the same or greater, then the troops will be safe.

SECTION 24—EXAMPLES OF INDIRECT FIRE ORDERS

1. Target of less width than gun frontage, without depth

Range guns—target, 1,600 yards.

Angle of sight 30' El.

Fire controller

N.C.O. i/c gun position.

Elevation.

All—Two degrees five five minutes.

Out aiming posts (or Pick up gun aiming marks).

Guns ready to load.

Load.

Right and Left 2 taps.

Wind (if required).

Fire.

Stop.

All—up 20 minutes—Go on.

2. Target equal to gun frontage, with depth of 200 yards

Range guns—target (near end) 1,465 yards, guns-target (far end) 1,640 yards.

Angle of sight near end 11' El., far end 15' El.

Fire controller

N.C.O. i/c gun position.

Elevation.

All—Two degrees one owe minutes

Out aiming posts (or Pick up gun aiming marks).

Guns ready to load.

Load.

Right and left 2 taps.

Wind (if required).

Fire.

Stop—All—Up 20 minutes.

Go on.

Stop—All—Up 20 minutes.

Go on.

3. Target greater than gun frontage, without depth

Range guns—target 1,810 yards.

Width of target $1^{\circ} 30'$. Angle of sight $22'$ El.

Fire controller

N.C.O. i/c gun position

Elevation.

All—Three degrees three owe minutes.

Out aiming posts (or Pick up gun aiming marks).

Guns ready to load.

Load.

Right and left 2 taps.

Wind (if required).

Fire.

Stop.

All—Up 25 mins.

Go on.

Stop.

All—left one degree.

Go on.

Stop.

All—Down 25 mins.

Go on.

Stop.

OR

All—Left one degree.

Go on.

Stop.

All—Up 25 mins.

Go on.

Stop.

All—right one degree.

Go on.

Stop.

SECTION 25—NIGHT FIRING

1. This section contains the arrangements to be made for engaging a target at night. It should be noted that these arrangements can be applied to conditions of bad visibility such as fog, dust or smoke.

2. The simplest method of applying fire by night is to lay the guns by day on the target either by direct or indirect means and then plant the pegs.

3. Before darkness falls, all data required to enable the various targets to be engaged must be obtained.

These include some or all of the following:—

The angles of sight and ranges to the various targets.

The angular width of the targets.

The angles of switch.

Data affecting any existing or possible safety problem.

4. When firing is carried out from positions behind the forward localities, special precautions, such as posting sentries or wiring the danger area, must be taken to ensure the safety of our own troops when passing near the gun position.

LESSON 86—RECONNAISSANCE BY DAY

Instructor's Notes

Stores.—Gun pegs, direction pegs and directors.

Method of instruction.—A simple tactical situation will be defined and the procedure explained. The squad will practise putting out the pegs.

1. If the target can be seen from the Gun position:—

(a) Mark the position for the pivot gun by a gun peg.

(b) Place a direction peg for the pivot gun in direct alignment between the gun peg and the correct position on the target for that gun. It is now desired to place the gun and direction pegs for the other gun on parallel lines to the pegs for the pivot gun.

(c) If No. 1 gun is the pivot gun:—

(i) Place the director over the gun peg of the pivot gun and lay on the direction peg with the arrow opposite 0° .

(ii) Swing the director sight through an angle of 90° to the left, and plant the gun peg for No. 2, approximately 30 yards away, and so that it cuts the line of sight through the director.

(iii) Now remove the director and place it directly over the gun peg of No. 2 gun, and lay on the gun peg of the pivot gun with the arrow opposite 0°.

(iv) Swing the director sight through an angle of 90° to the left and plant the direction peg for this gun as described in (ii).

The pegs of No. 2 gun will now be parallel to those of No. 1 Gun.

2. When the guns are brought up, the procedure is as described in Section drill—Night firing (Section 15, Lessons 48 and 49).

3. When the guns have been laid, direction is maintained by means of the dial and elevation by means of the clinometer.

LESSON 87—THE RELIEF OF GUNS BY NIGHT

Instructor's Notes

Stores.—Two or more guns and tripods, with complete night firing equipment.

Method of instruction.—The guns will be in position, laid for direction and elevation.

The procedure of relief will be carried out in detail.

Where opportunity offers, from this lesson can be developed the full process of occupation and relief by two separate sections.

Explain

1. The N. C. O. i/c the relieving gun will make sure that the gun peg is accurately placed for his gun.

2. The aiming peg will be left out.

3. The gun to be relieved will then be removed and the relieving gun will be mounted accurately by means of the gun peg and laid for direction on the old aiming peg. Its dial will then be zeroed.

4. Elevation is put on by means of the clinometer and direction maintained by means of the dial.

5. The range card and all fire control details will then be handed over to the relieving unit.

LESSON 88—LAYING A FIXED LINE BY NIGHT, WHEN NO RECONNAISSANCE BY DAY HAS BEEN CARRIED OUT

Instructor's Notes

Stores.—Gun, tripod, clinometer, complete night firing equipment.

1. Explain and demonstrate

(a) A light will be shown in the direction of the guns from a position on which the fixed line is to fall.

The position must be chosen with due regard to safety.

(b) (i) Obtain the range by range-finder to the light.

(ii) Lay the gun on the light, by means of the sight set at this range. It may be necessary to assist with a torch. Zero the dial.

(iii) Fix the night sights and re-align the line of sight on the light.

(iv) Check the elevation on the gun by means of the clinometer.

(v) Load as soon as the individual showing the light has cleared the line of fire.

2. Until those under instruction become proficient, practice in the open is best done by daylight.

SECTION 26—FIRE DIRECTION AND CONTROL CHARTS

1. For the conduct of programme shoots, when fire is required at varying periods on one or more targets, it will generally be preferable to issue charts for the direction and control of fire. This will usually apply to shooting off the map and to firing by night; for example, in the provision of covering fire for a dawn attack, harassing fire, counter-preparation, etc.

2. Fire direction charts will be prepared by the support platoon commander, with the object of allotting tasks to individual sections. A suitable form is shown on page 71.

3. Fire control charts are made up by section commanders, one for each gun, and are interpreted by a N.C.O. at each gun. They are prepared from data obtained from the fire direction chart, if issued, and by measurement.

The chart contains the actual detail of switches, timing and rates of fire, and the elevation and amount of traverse to be employed for each target. A suitable form is shown on page 72.

When firing indirect by day, it will often be advantageous to prepare a simplified form of chart for use at the guns.

LESSON 89—PREPARATION OF CHARTS

Method of instruction.—Officers will be instructed in the preparation of both types of chart.

N. C. Os. will study only the preparation of fire control charts. They will be given the fire direction chart and instructed in compiling the fire control chart.

1. Explain

The angle of deviation of any target is the actual deflection from zero to bring the gun on to its correct position on that target.

2. It should be noted that both the Q.A. as calculated for normal atmospheric conditions, and the Q.A. corrected for the conditions at the time of firing, are entered on the chart, if necessary.

FIG. 24
FIRE DIRECTION CHART

Ref.	Unit and Role	Location	Task	Time		Rate of fire	Remarks
				From	To		
	No. 1 Section (Supporting guns).	Track junction W. Corner of Robin Hood Ball 544666.	1. N. W. corner New-foundland Farm 5468 to 50x W. along track.	Zero	Z + 4.	Rapid	
		Guns laid on right end of Old Farm Clump.	2. Junction of tracks 539683 to 50x S.W.	Z + 10	Z + 14.	Normal	
			Fixed line Cross Tracks 542685 to 50x East.	S.D.F. Red, green, red.		2 min. Rapid. 3 min. Normal.	

Signed F. J. BLANK, Capt.,
Commanding Support Platoon.

Task	Clock time		Zero time		Angle of deviation from zero	Normal Q.A.	Corrected Q.A.	Tapping R. & L. Taps.	Side Wind Allowance	Rate of fire	Remarks
	From	To	From	To							
1			Zero	Z + 4	R. 12° 40'	2° 50' Lift 25'		2		Rapid {	2 minutes on each elevation.
2			Z + 10	Z + 14	L. 6° 40'	3° 45' Lift 30'		2		Normal {	1 minute on each elevation alternately.
Fixed line.	RED	S.D.F. GREEN	RED.	RED.	Zero	4° 50' Lift 35'		2		2 min. Rapid 3 min. Normal & Repeat once.	5 minutes on each elevation.

Signed G. SMITH, Corporal,
Section Commander.

N.B.—Q. As. are always elevation if not marked DEP.
Date.....

(i) All ranks of the support platoon must be proficient in the use of the Clinometer, Bar-foresight, Aiming post, Direction Dial, Elevating wheel and Night sight.

(ii) Officers and N. C. Os. must be proficient in the use of the slide rule. The former and full rank N. C. Os. will also be trained to use the director.

(iii) In addition to the above, all Officers and N. C. Os. should be able to determine whether a Clinometer is in adjustment. Similarly those Officers and N. C. Os. who are trained in the use of the Director should be able to test the instrument for accuracy.

The detail of these tests is given in the following lessons.

2. Method and sequence of instruction

(i) The various instruments will be explained and their employment demonstrated.

(ii) The personnel concerned will be practised in the use of the instruments.

LESSON 90—DIRECTOR, No. 4, MARK II

(PLATES V AND VI)

Instructor's Notes

Stores.—Directors.

1. Explain and demonstrate

Focusing of telescope.

Pointer.

Degree scale on director.

Clinometer level and elevating gear.

Degree scale plate.

How to clamp the index plate and the functioning of the clamping screw.

Use of spirit level on stand.

Hook attached to base plate.

2. Describe how the instrument consists of :—

A telescope with vertical pointer contained in the box. The telescope can be focused by means of the eyepiece.

On the left of the box is a clinometer level, consisting of a bubble arm, degree scale, and micrometer heads marked in 5s of minutes. The top half of the degree scale and the top drum for elevation, the bottom half of the scale and the bottom drum for depression.

On the underside is a slider and spring for attaching to the director stand.

The director stand consists of three hinged legs, between which is a hook for use with a plumb line. The legs are attached to a circular plate, to which is attached the clamping socket.

The clamping socket rotates, and has a clamping screw for clamping the socket to the base.

The degree scale plate is attached to the top of the clamping socket, and is marked in degrees from 0 to 180 right and left (R. and L.).

Above this is the index plate, which has an arrow inserted on the outer edge. On this plate is a milled nut for clamping the plate to the degree scale plate, and a spirit level for getting the director stand upright, and a compass.

The carrier to which the director slider is attached is elevated or depressed by means of the slow motion elevating gear.

The springs on the carrier and slider are for taking up play.

3. Show how to set up the director.

Remove the director from the case, and the director stand.

Fit the base of the director into the carrier.

Splay out the legs of the stand so that the director is at a convenient height. It will be found that the kneeling position is the most suitable, but a lower position may have to be adopted. Press the legs firmly into the ground. Make sure that the degree scale plate is approximately level.

4. Show how to take an angle of sight.

Focus the telescope. Unloosen the clamping screw. By means of the elevating gear and milled portion of the clamping socket lay the tip of the pointer on the target.

By means of the milled head below the depression micrometer head, level the bubble. Read the angle of sight by means of the degree scale and micrometer heads. Once the bubble has been levelled, the reading of the angle of sight may be taken later at any convenient time. Readings to be to the nearest minute.

When finished with, the arrows will be set at zero.

5. Explain how to measure the lateral angle between two points.

Set the pointer on the index plate opposite "zero" on the degree scale.

Tighten up the clamping nut. By means of the elevating gear and milled portion of the clamping socket, lay the pointer on the first point. Tighten up the clamping screw.

Loosen the clamping nut and lay the pointer on the second point.

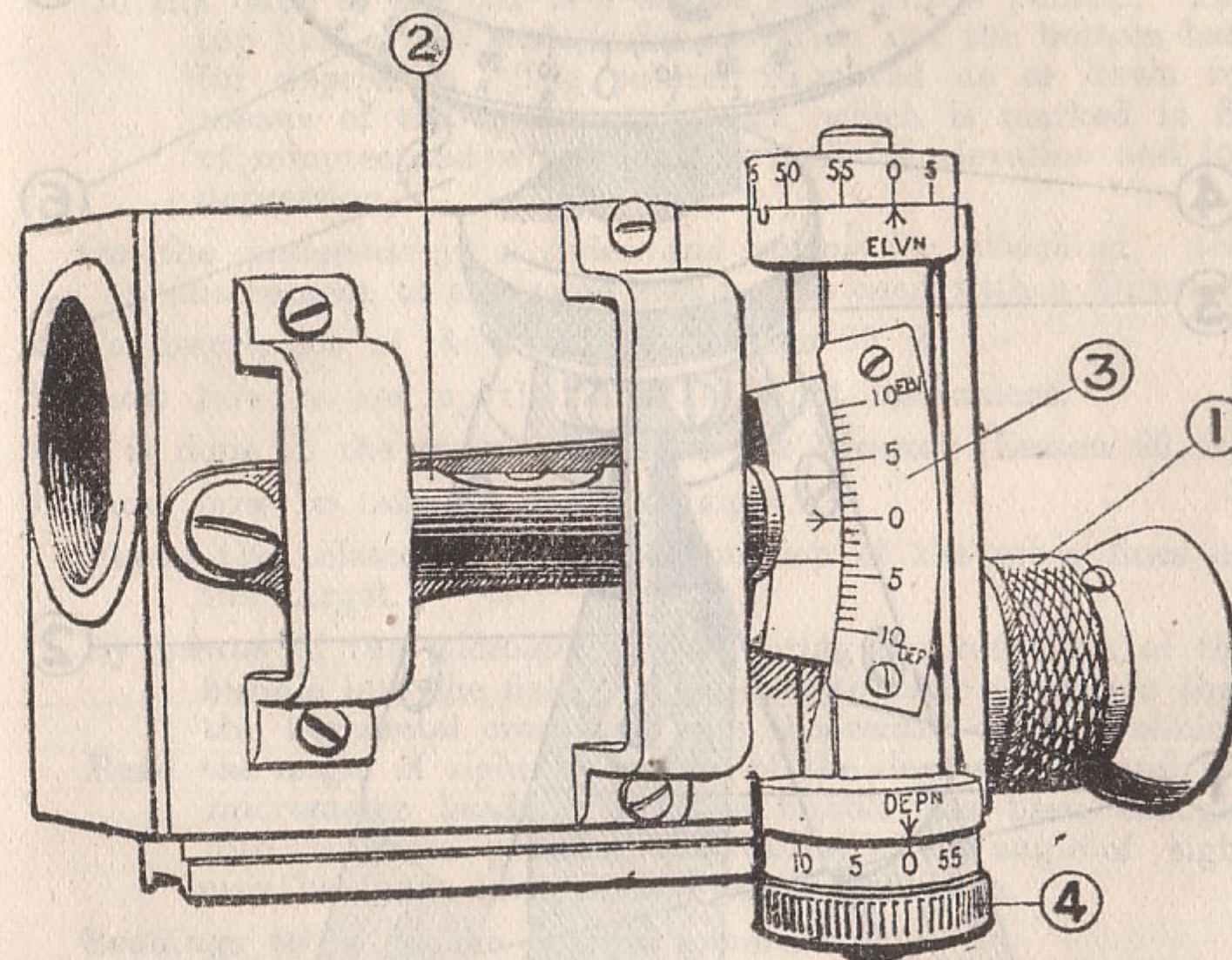
Read off the number of degrees and minutes, direction right or left, from the degree scale to the nearest 10 minutes. Ensure that the degree scale plate does not slip when the index plate is moved. Always move the index plate by holding the carrier bracket, and not the director.

Before putting the director stand in its case, set the slide horizontal, clamp the compass and set the pointer on the index plate at 0 degrees.

6. Practise squad.

PLATE V

DIRECTOR, NO. 4, MARK II

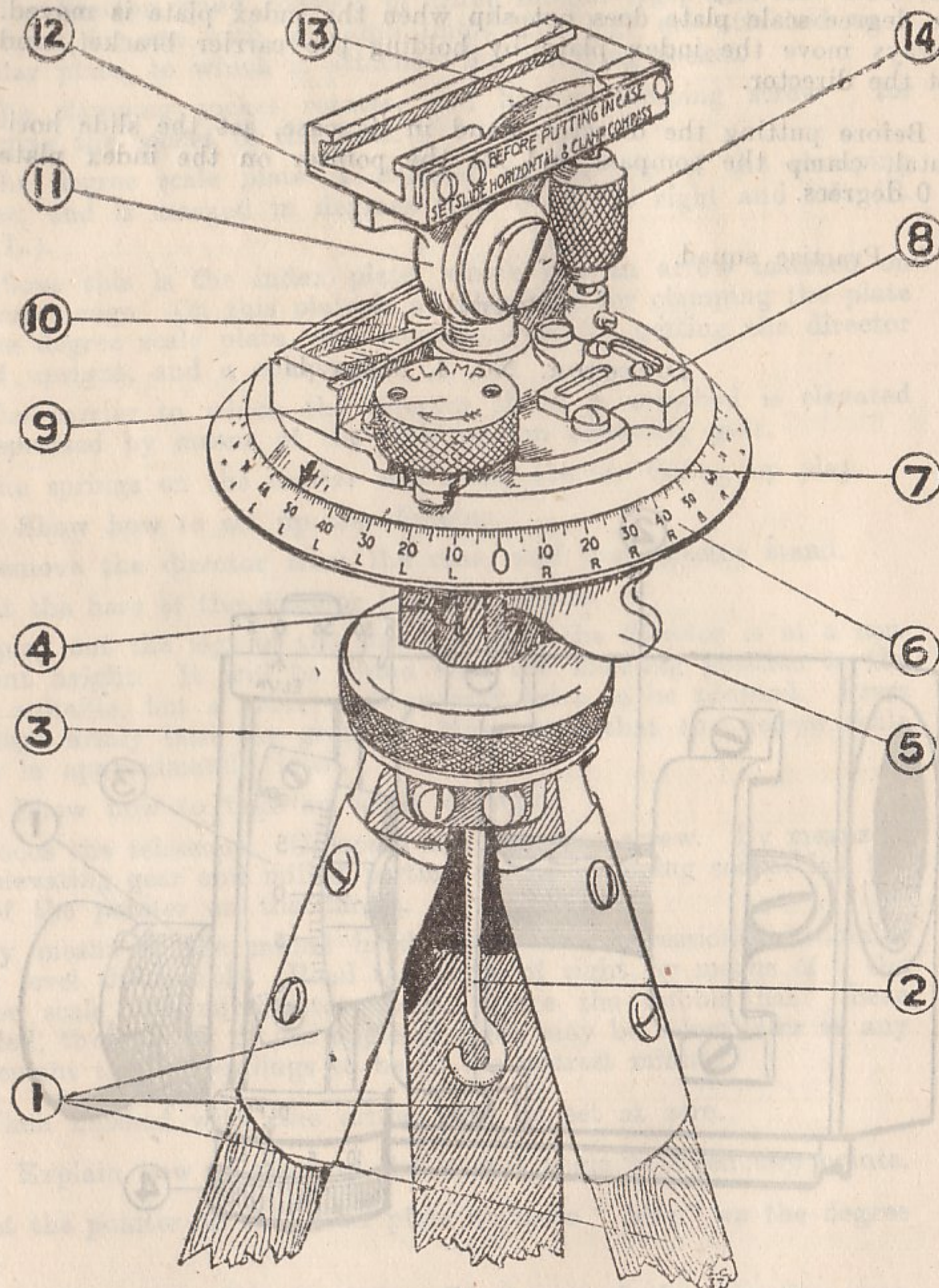


KEY

- | | |
|----------------------------|---------------------------------|
| 1. For focusing telescope. | 3. Angle of sight degree scale. |
| 2. Clinometer level. | 4. For levelling bubble. |

PLATE VI

STAND DIRECTOR, No. 4, MARK II



KEY

- | | | |
|---------------------|------------------------|----------------------|
| 1. Legs. | 6. Degree scale plate. | 11. Carrier bracket. |
| 2. Hook. | 7. Index plate. | 12. Carrier. |
| 3. Base plate. | 8. Spirit level. | 13. Side spring. |
| 4. Clamping socket. | 9. Clamping nut. | 14. Elevating gear. |
| 5. Clamping screw. | 10. Magnetic compass. | |

LESSON 91—ANGLE OF SIGHT INSTRUMENT

(PLATE VII)

*Instructor's Notes**Stores.—Angle of Sight Instrument.*1. **Explain and demonstrate**

For focusing telescope.

Cross lines.

Degree scale on instrument.

Bubble and how to level it.

2. Describe how the instrument consists of:--

A telescope with cross lines, contained in the box. The telescope can be focused by pulling out or pushing in the eyepiece.

On the top of the box is a glass plate, inside which can be seen a bubble. A reflection of this bubble can also be seen through the telescope.

On the back of the box is a degree scale with a pointer. The top half of the scale is for elevation and the bottom half for depression. The pointer is moved up or down by means of the micrometer head, which is marked in 5s of minutes and which is used both for elevation and for depression.

On the underside is a slider and spring for attaching the instrument to the same stand as is used with a Director.

For a description of the stand, see Lesson 90, 2.

3. Show how to set up the angle of sight instrument.

This is done in the same manner as the Director (Lesson 90, 3).

4. Show how to take an angle of sight.

Focus the telescope. Lay the junction of the cross lines on the target.

By means of the micrometer head, bring the reflection of the bubble into the field of view and to such a position that the horizontal cross line cuts the centre of the bubble.

Read the angle of sight by means of the degree scale and the micrometer head. Once the bubble has been brought into its correct position, the reading of the angle of sight may be taken later at any convenient time.

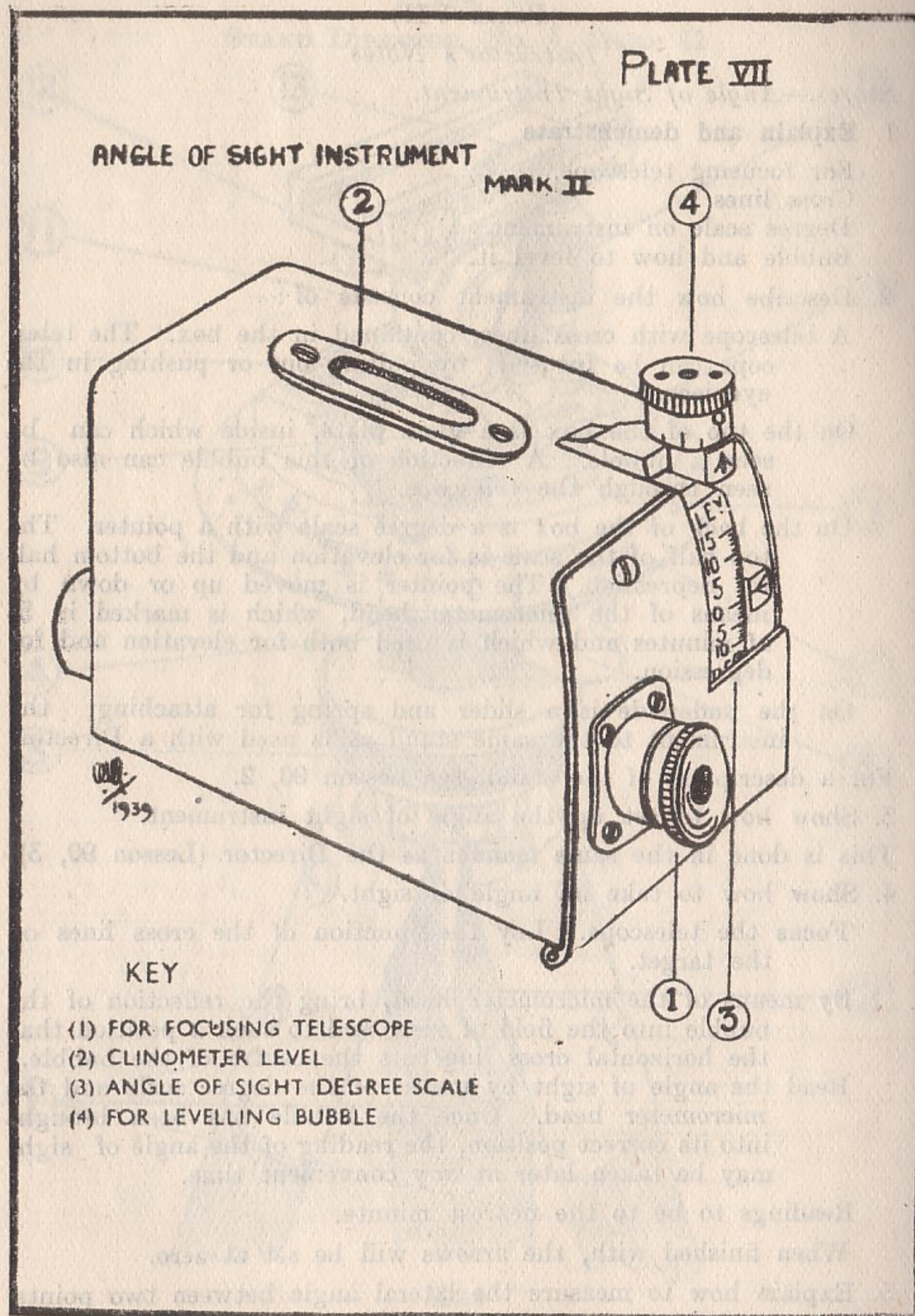
Readings to be to the nearest minute.

When finished with, the arrows will be set at zero.

5. Explain how to measure the lateral angle between two points.

This is done in the same manner as with a Director—See Lesson 90, 5.

6. Practise the squad.



LESSON 92—TESTING THE DIRECTOR OR ANGLE OF SIGHT INSTRUMENT FOR ANGLE OF SIGHT

Instructor's Notes

Stores.—Directors or Angle of Sight Instruments.

1. Select a position where there are two walls or upright posts, about 200 yards apart, and as far as possible in the same horizontal plane.

2. Take the instrument to one wall (A), if possible at the corner of a house. If testing a No. 4, Mark II, director or angle of sight instrument, set the degree and minute scales to zero. (This should not be necessary with a later pattern director.) Now lay the instrument on the other wall, and by means of the elevating gear centralize the bubble.

Look through the telescope and direct some one to mark the point aimed at on a distant wall (B). Mark the wall where you are standing at (A) at the same height as the subject glass of the instrument.

3. Take the instrument to the distant wall (B), and place the object glass against a mark (B) made on the wall. In the case of the No. 4, Mark II, director or angle of sight instrument, keep the degree scale to zero. Bring the bubble to the centre of its run by means of the elevating gear.

If the instrument is now found to be laid on the mark (A), it is in adjustment.

4. If it is desired to test more than one instrument it is necessary to obtain a horizontal line.

If, as in para. 3 above, the instrument is found to be laid on the mark (A), the line joining (B) and (A) is a horizontal line, and it may be used to test other instruments.

If the instrument is found not to be laid on (A), the bubble being central, direct some one to mark the spot on which it is laid (C).

Now make a third mark (D) on the first wall, exactly halfway between (A) and (C). This mark (D) in conjunction with the mark (B) will form a horizontal line.

To prove accuracy it is advisable to place the instrument at (D) and check back on (B).

When the horizontal line has been obtained the other instruments can be checked and adjusted on it.

5. Having laid out a horizontal line, proceed to test the instrument.

In the case of the No. 4, Mark II, director or angle of sight instrument, set the degree and minute scales to zero. (This is not necessary with later pattern directors.)

Place the object glass at one end of the horizontal line and lay on the point with the elevating gear at the other end of the line laid out. The bubble should then be central; if it is not, turn the micrometer head until it is so and note the error.

In the case of directors of later pattern than the No. 4, Mark II, it is only necessary to lay on the opposite mark and note that the bubble is central. If the bubble is not central, elevate or depress the telescope until it is so and note the error through the eyepiece.

NOTE.—Where adjustment is necessary, it will be carried out by an Armourer.

LESSON 93—CLINOMETER, VICKERS .303 INCH, MARK I

(PLATE VIII)

Instructor's Notes

Stores.—Clinometer, gun and tripod.

1. Explain and demonstrate.

Placing on gun.

Setting for elevation or depression.

2. Description

This instrument consists of a "cradle" (A). The upper surface is cut to form the arc of a circle in which the arc (N) can slide.

A scale of degrees (C) from zero to 20 degrees elevation and depression is engraved on one face and is read from an arrow (D) on the arc. The graduations for elevation and depression are filled in with black and are numbered every 5 degrees and followed by the letters "E" and "D" respectively.

A worm spindle is fitted in two bearings in the cradle, one end (E) being on a pivot. This allows the worm to be put out of gear with the arc, for quick setting, by pressing downwards on the other end (F) of the worm spindle.

A spring is provided to keep the worm spindle and arc in gear.

Two micrometer collars are fixed to the worm spindle, one (G) for reading depression in minutes, the other (H) for reading elevation in minutes.

The micrometer collars are divided every five minutes and numbered every ten minutes, and are coloured the same as the degree scale. The figures on the micrometer collars have the letters "E" and "D" engraved underneath to indicate elevation and depression, respectively.

At one end of the worm spindle a milled head (J) is firmly attached; one turn of this milled head represents one degree.

The arc (N) is shaped to slide in the cradle. On its under surface are teeth into which the worm gears. Attached to it by two screws is an adjustable reader (K) for the degree scale. On its upper surface is attached a spirit-level (L).

At the back of the instrument is a bracket which fits into another bracket on the gun.

3. To test the clinometer

i. With a director or angle of sight instrument which has already been tested and adjusted, measure the angle of sight to two or more points from gun height.

ii. Place the clinometer on the gun and with the sight at zero lay on one of the points and then adjust the clinometer until the bubble is in the centre of its run. Note the difference in the reading on the clinometer to that of the director (if any). This will be the error of the clinometer.

iii. Test in a similar manner on another point. The difference should be the same in each case.

4. If a clinometer of another gun is known to be correct, that gun and its clinometer can be used to find the correct angle of sight to the different points instead of a director.

Each clinometer should be tested for its own gun.

NOTE.—When rotating the minute drum always turn to the left last, i.e., anti-clockwise.

When the clinometer has been adjusted, test again on two or more points.

5. To adjust the Clinometer

Set the clinometer at the error noted. With a spanner loosen the "nuts securing micrometer collar," set the scale to zero and tighten up.

If the variation is large, it may be necessary to reset the degree reader. This is done by loosening the two securing screws and

sliding the reader to right or left, as may be necessary, and then clamping up.

NOTE.—Adjustments will be carried out only by Armourers.
CLINOMETER, VICKERS 303-IN. M. G. MARK I (MODIFIED)

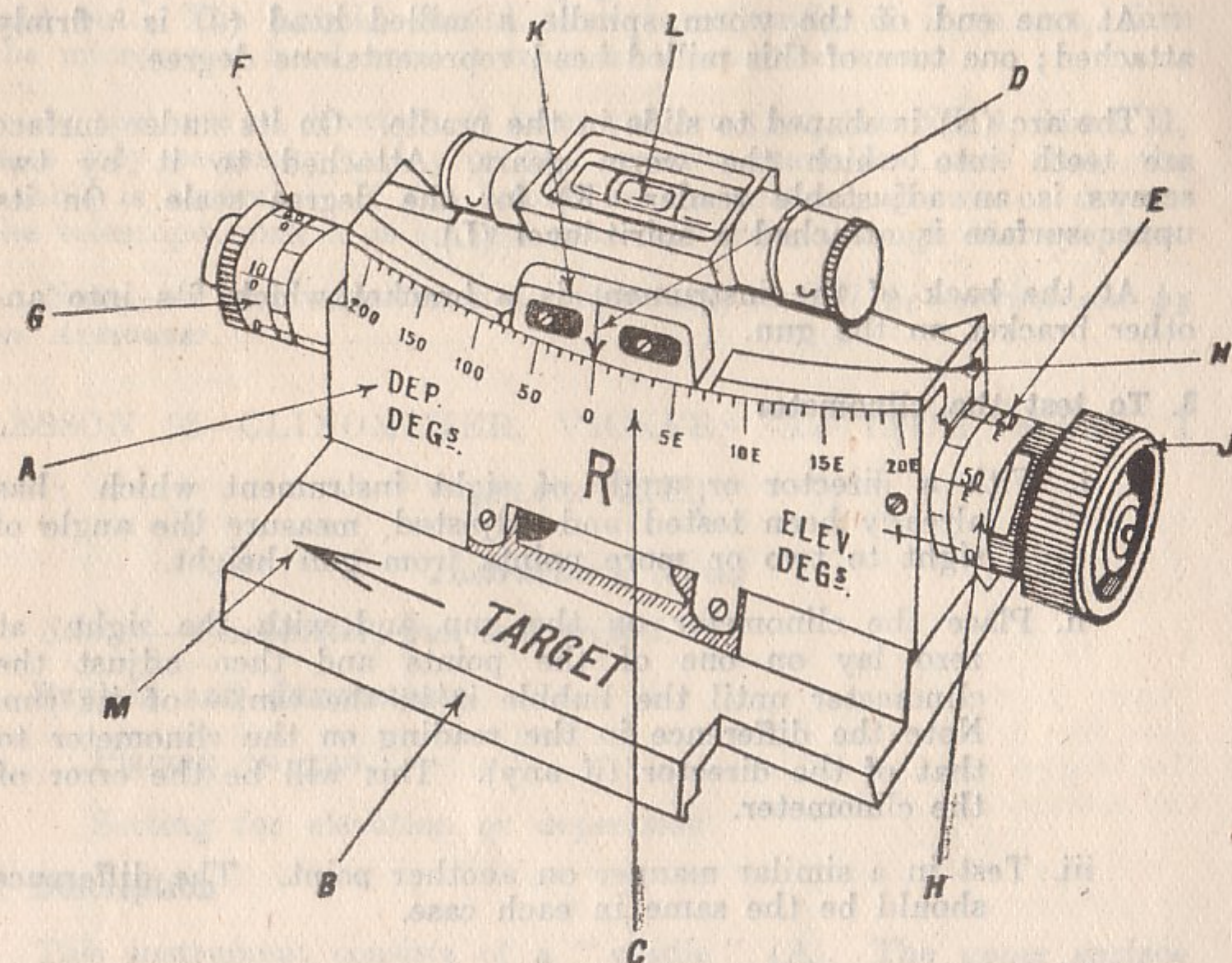


PLATE VIII

LESSON 94—RULE, SLIDE, M.G., MARK I

Instructor's Notes

Stores.—Slide rules.

1. Explain and demonstrate

The following scales, etc., are engraved on the slide rule:—

- Safety angle scale.
- Degree scale.
- V.I. and H.E. scale.
- Wind scale.
- Barometer and temperature scales.
- 1 in 20,000 scale, showing yards.
- 1 inch to 1 mile scale, showing yards.
- Degree scale similar to that on the service protractor.
- Range Tables.

2. Description

(a) Safety angle scale

Engraved on the rule is a range to target scale marked in hundreds of yards from 600 to 2,800, and opposite to this on the slide is a range to troops scale marked in black from 600 to 2,000 yards and in red from 500 to 100 yards.

The safety angle scale is used in accordance with the instructions laid down in Lesson 70.

Amendments No. 1.

- Page 83, paragraph 2 (a). Add new sub-paragraph:—
"It is preferable to use graticule glasses or monoculars when using the Safety angle scale, since great inaccuracies can creep in if the cord is not exactly 24 inches long."

Amendments 1/1940.

When measuring angular widths when the rule is held at the length of the cord from the eye. The amount of the slide projecting at the top of the rule will cover on the ground the degrees and minutes shown opposite the arrow on the top right corner of the slide.

(c) V.I. and H.E. scale

A V.I. scale is marked in hundreds of yards from 300 to 10. In conjunction with this is an H.E. scale marked in hundreds of yards from 3,000 to 100, and a degree scale marked from 0° to 10.

An arrow marked on the slide enables angles to be read off in conjunction with the V.I. and H.E. Scales.

(d) Wind scale

On the reverse side of the slide are marked allowances for a 20 m.p.h. wind. The allowance for a side wind is shown on one side and marked from 115 minutes to 10 minutes, and on the other side is the allowance for head or rear wind marked from 90 minutes to 5 minutes.

A wind pointer is provided in the centre of the top cut-away portion on the back of the rule.

Place the arrow marked "Wind on reverse" to the range to the target. Turn the slide rule over and read the wind allowance by the arrow in the recess at the top of the rule. The left hand side of the slide gives readings for side winds and the right-hand side gives readings for head winds.

(e) Barometer and temperature scales

On the reverse side of the slide is also marked the allowance for 1 inch of barometer from 5 minutes to 25 minutes.

Handwritten signature: "H. C. ..."

sliding the reader to right or left, as may be necessary, and then clamping up.

NOTE.—Adjustments will be carried out only by Armourers.
CLINOMETER, VICKERS .303-IN. M. G. MARK I (MODIFIED)

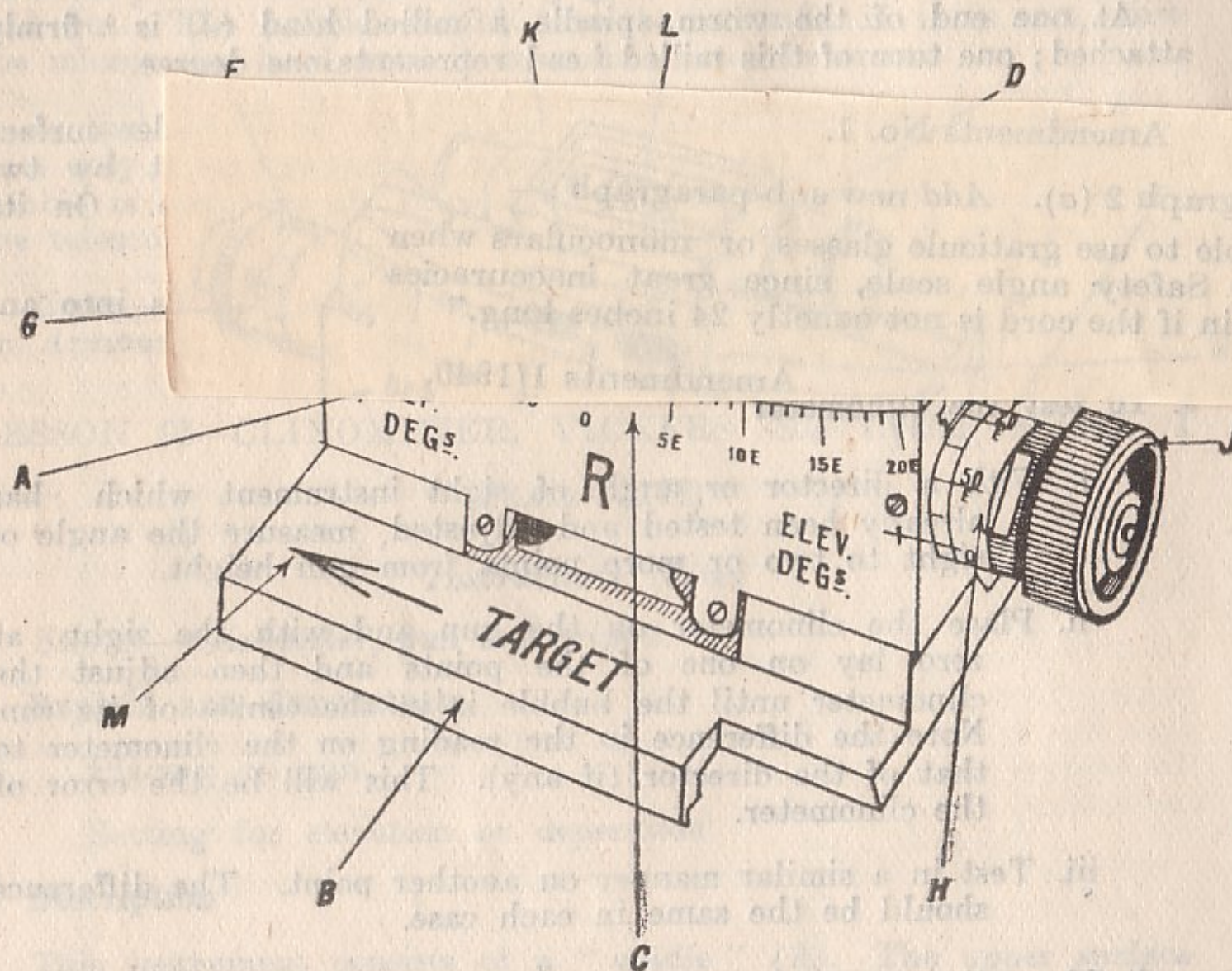


PLATE VIII

LESSON 94—RULE, SLIDE, M.G., MARK I

Instructor's Notes

Stores.—*Slide rules.*

1. Explain and demonstrate

The following scales, etc., are engraved on the slide rule :—

- (a) Safety angle scale.
- (b) Degree scale.
- (c) V.I. and H.E. scale.
- (d) Wind scale.
- (e) Barometer and temperature scales.
- (f) 1 in 20,000 scale, showing yards.
- (g) 1 inch to 1 mile scale, showing yards.
- (h) Degree scale similar to that on the service protractor.
- (i) Range Tables.

2. Description

(a) *Safety angle scale*

Engraved on the rule is a range to target scale marked in hundreds of yards from 600 to 2,800, and opposite to this on the slide is a range to troops scale marked in black from 600 to 2,000 yards and in red from 500 to 100 yards.

The safety angle scale is used in accordance with the instructions laid down in Lesson 70 for which purpose a cord 24 inches in length is attached to the top of the slide rule.

Care must be taken that this cord does not become knotted and is exactly the correct length.

(b) Degree scale

In addition to being used in conjunction with "Range to Target" and "Range to Own Troops" scale (Lesson 68), this scale can be used for measuring angular widths when the rule is held at the length of the cord from the eye. The amount of the slide projecting at the top of the rule will cover on the ground the degrees and minutes shown opposite the arrow on the top right corner of the slide.

(c) *V.I. and H.E. scale*

A V.I. scale is marked in hundreds of yards from 300 to 10. In conjunction with this is an H.E. scale marked in hundreds of yards from 3,000 to 100, and a degree scale marked from 0° to 10° .

An arrow marked on the slide enables angles to be read off in conjunction with the V.I. and H.E. Scales.

(d) *Wind scale*

On the reverse side of the slide are marked allowances for a 20 m.p.h. wind. The allowance for a side wind is shown on one side and marked from 115 minutes to 10 minutes, and on the other side is the allowance for head or rear wind marked from 90 minutes to 5 minutes.

A wind pointer is provided in the centre of the top cut-away portion on the back of the rule.

Place the arrow marked "Wind on reverse" to the range to the target. Turn the slide rule over and read the wind allowance by the arrow in the recess at the top of the rule. The left hand side of the slide gives readings for side winds and the right-hand side gives readings for head winds.

(e) *Barometer and temperature scales*

On the reverse side of the slide is also marked the allowance for 1 inch of barometer from 5 minutes to 25 minutes.

H. C. M. D. W.

Allowance for 20° of temperature is also marked from 5 minutes to 35 minutes.

A pointer is provided in the centre of the bottom cut-away portion on the back of the rule.

Set the arrow marked "Temp. and Bar. on reverse" to the range to the target. Reverse the slide rule, and the necessary allowances can be read opposite the arrow in the recess at the bottom of the rule.

Barometer is on the left and temperature on the right.

(f) 1/20,000 scale

This scale is shown in divisions of 50 yards, and larger divisions mark the hundred, five hundred and thousand yards. The thousand marks are numbered in full.

(g) 1-in. to 1 mile scale

This scale is marked in divisions of one hundred yards each and the larger divisions are one thousand yards.

(h) Degree scale—protractor.

In the centre of the sloping side is a protractor degree scale marked from 0° to 90° and used in conjunction with the 0 on the other sloping side of the rule.

(i) Range Tables

On the back of the slide are marked the following extracts from the Range Tables:—

Tangent angles; Angles of descent of the bullet; Length of beaten zones and cones; Position of lowest shot below centre of cone.

3. Practise squad.

LESSON 95—NIGHT AIMING AND USE OF NIGHT SIGHTS

Instructor's Notes

Stores.—Gun and tripod, night sights, and 2 pegs.

1. Description

(1) The foresight consists of rectangular steel plate, shaped and pierced to form the sighting features, and mounted on a steel body with spring arms, by means of which it is attached to the gun foresight protectors.

The sighting features include a rectangular opening, projecting from the lower edge of which is a combined aperture and blade.

(2) The back sight consists of a vertical rectangular steel plate pierced to form a sighting aperture. The plate is secured to a small steel body to which is attached a spring clip for engagement with the Tangent sight slide of the gun.

(3) The aperture in the blade of the foresight is used in conjunction with the sighting aperture of the backsight for obtaining direction from the direction peg.

2. Practise the squad.

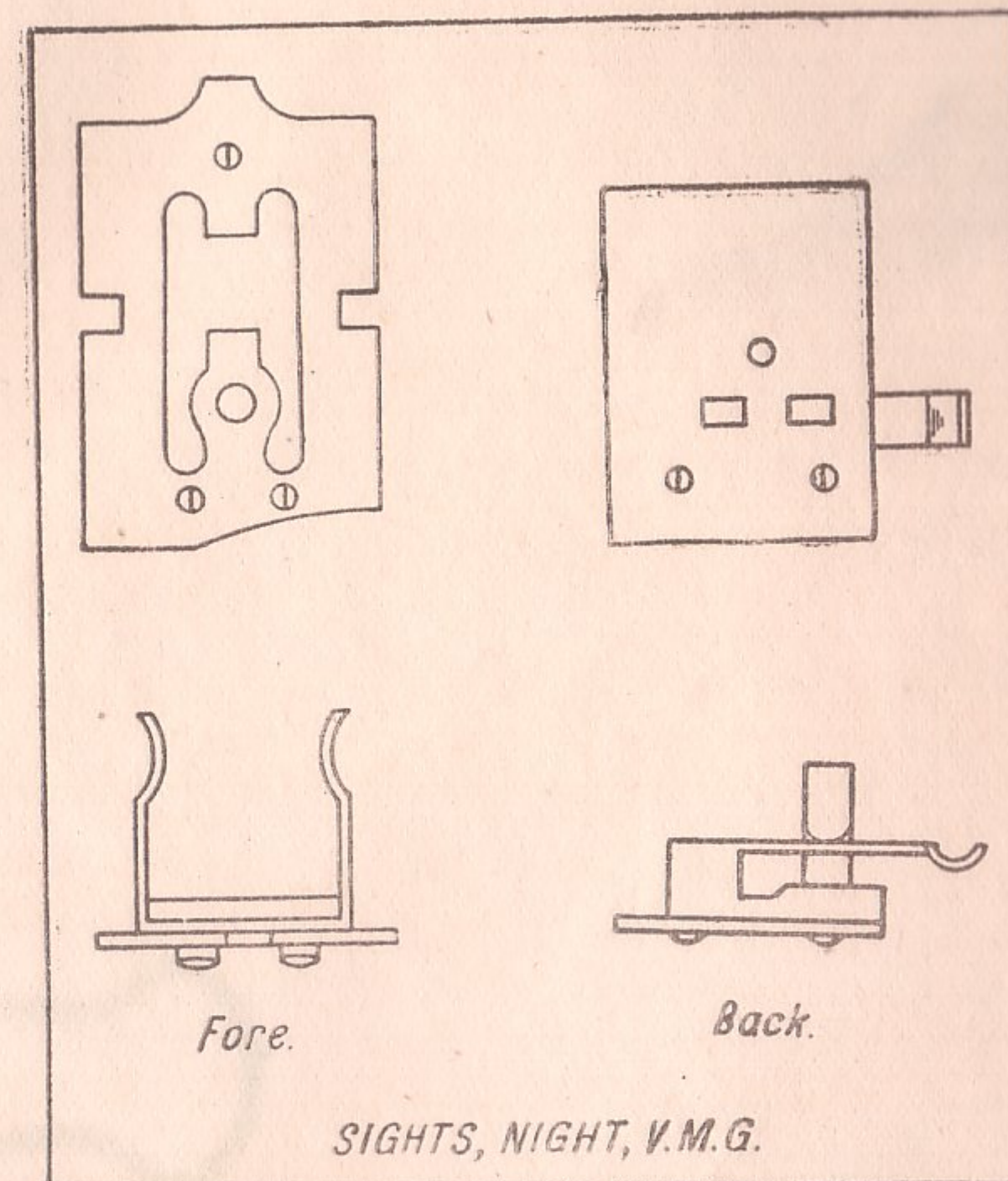
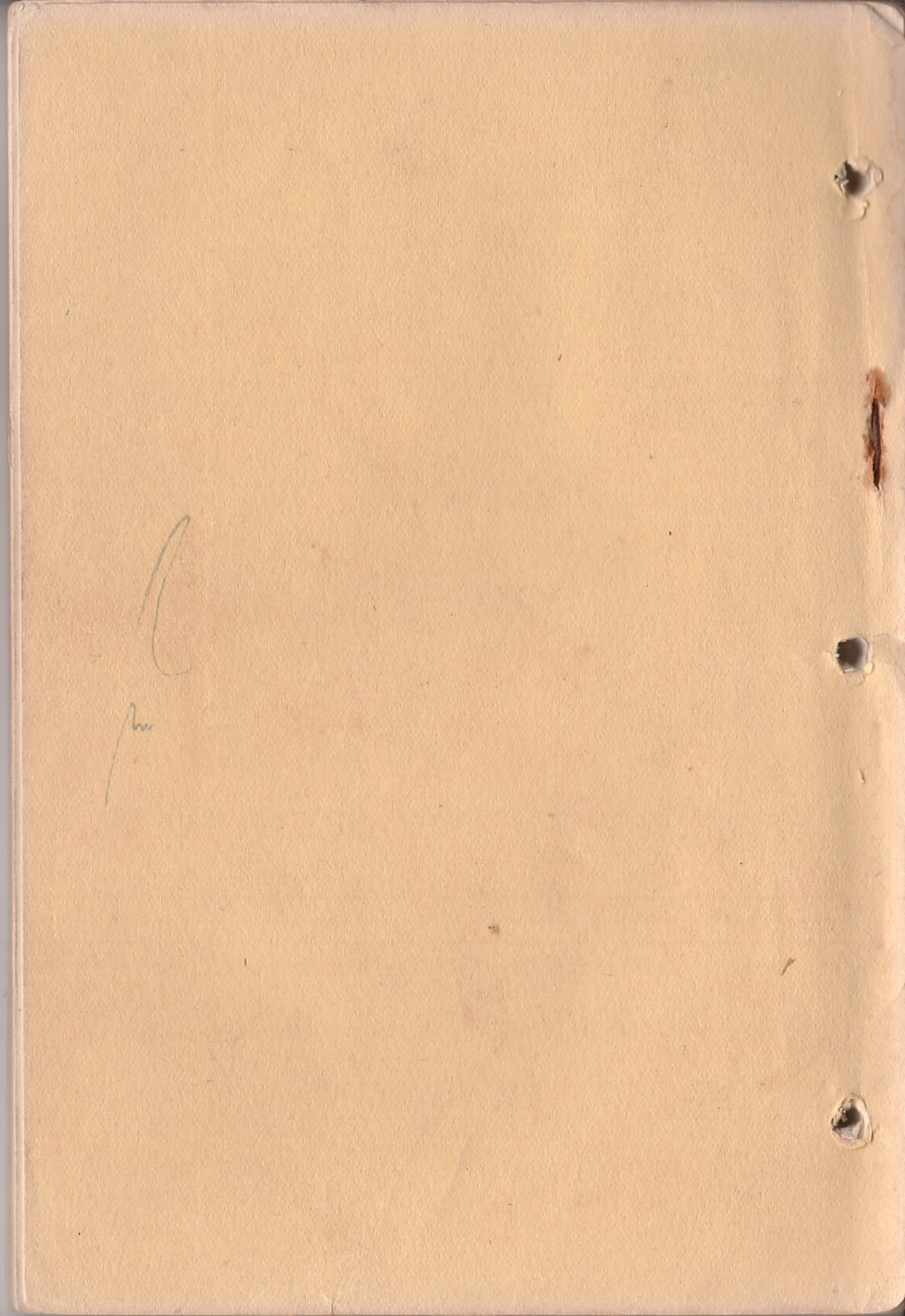


PLATE IX





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